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TABLE OF CONTENTS

ARTICLES

PAGE

Spenser's Acrasia and the Circe of the Renaissance
Merritt Y. Hughes 381

Galileo and Plato ..... *Alexandre Koyré* 400

Attitudes of Some Modern Rationalists to History
Jerome Rosenthal 429

NOTES AND DOCUMENTS

The Authentic Title of Copernicus's Major Work
Edward Rosen 457

Saint-Simon, the Utopian Precursor of the League of Nations
Elliott H. Polinger 475

BOOK REVIEW

Sir James Jeans's *Physics and Philosophy*.....*Philip P. Wiener* 484

RECENT BOOKS AND PERIODICALS RECEIVED 490

ANALYTICAL AND NAME INDEXES 497

TABLE OF CONTENTS OF VOLUME IV 506

VOLUME IV OCTOBER 1943 NUMBER 4

SPENSER'S ACRASIA AND THE CIRCE OF THE RENAISSANCE

BY MERRITT Y. HUGHES

No passage in *The Faerie Queene* is harder for modern taste to accept than the close of the second book. For one defense of the allegory of Acrasia like that by Mr. Lewis[1] in *The Allegory of Love* there are a dozen condemnations of the "Puritanism" which revelled in Guyon's destruction of the Bower of Bliss, and of the "Neo-Platonism" to which Mr. Traversi says[2] that Spenser was attracted by his morbid belief that "body is body, and can only meet spirit by degrading it." When it comes to Guyon's famous curse on Gryll, the only one of Acrasia's beasts to refuse to be disenchanted and resume his lost human form, most of us applaud the hog's "stubborn individuality," to which Professor Bush confesses that "the irrational part of one's soul accords a degree of admiration."[3] Modern taste is inclined to regard Acrasia as a deplorable travesty of Homer's Circe, and in her and in other Renaissance Circes like Tasso's Armida and Trissino's Acratia modern criticism sees simply an illustration of Dr. Erwin Panofsky's principle that "some periods have been unable and unwilling to realize that classical *motifs* and classical *themes* structurally belonged together."[4] Dr. Panofsky says this of the Middle Ages, but many studies such as Dr. Trinkhaus's *Italian Humanists on Happiness*[5] and Professor Farnham's *Medieval Heritage of Elizabethan Tragedy*[6] have uncovered much surviving "medieval" thought in the sixteenth century. Is it possible then that we should regard Spenser's allegory of Acrasia and Gryllus as an unhappy projection into the English Renaissance of what Dr. Panofsky calls

[1] C. S. Lewis, *The Allegory of Love* (Oxford, 1936), 319–30.

[2] D. A. Traversi, writing in *Scrutiny* (Vol. V), 284.

[3] Douglas Bush, *Mythology and the Renaissance Tradition* (Minneapolis, 1932), 114.

[4] Erwin Panofsky, *Studies in Iconology. Humanistic Themes in the Art of the Renaissance* (New York, 1939), 28.

[5] Charles E. Trinkhaus, *Adversity's Noblemen. The Italian Humanists on Happiness* (New York, 1940).

[6] Willard E. Farnham, *The Medieval Heritage of Elizabethan Tragedy* (Berkeley, 1936).

the "Jewish-Christian conception of man, . . . based on the idea of the 'clod of earth' forcibly, or even miraculously, united with an immortal soul"?

The fact is that Spenser's anthropology owed much to the Middle Ages, though hardly more than did Shakespeare when he made Hamlet describe man as "the paragon of animals," or more than did Leonardo da Vinci in regarding man as the *prima bestia infra le animali.* The bond of those conceptions with the belief of Neo-Platonists like Pico della Mirandola in the dignity of man has often been pointed out, but the place of St. Thomas Aquinas' view of man as *optimus animalium*[7] in their composite ancestry is ignored. Later we must return to this faith in man as the paragon of animals, which belonged to both the Middle Ages and the Renaissance. But first we must look at Spenser's Gryll and his unblushing resolve, in spite of all that Guyon can say against his pig-headedness, to "keep his hoggish mind."

If we consult either of the variorum editions of *The Faerie Queene,* we find that since 1734 scholars have been content to follow Jortin's explanation of the closing scene in the second book as stemming from Plutarch's dialogue *Whether the Beasts have the Use of Reason,* "where Gryllus, one of the companions of Ulysses, transformed into a hog by Circe, holds a discourse with Ulysses and refuses to be restored to his human shape."[8] Of that much all editors are sure. They also favor Warton's suggestion that Spenser found his way to Plutarch through the "very popular" *Circe* of the Florentine cobbler, Gianbattista Gelli, in the English translation of Henry Iden (1557).[9] The history of modern interpretation of Gelli's *Circe,* from Leopardi's pessimistic reaction to its supposed "theriophily" to Professor Boas' welcome of it for that quality's sake in *The Happy Beast,*[10] does make its true influence on Spenser hard to assess. Its relation to *The Faerie Queene* is much less certain than its own dependence and that of Spenser's Gryll also upon the tradition that descended from Plutarch and was running to seed when, in the *Inner Temple Masque* of Ulysses and Circe (acted, 1614), William Browne of Tavistock introduced

[7] *Summa contra Gentiles,* III, xxxii.

[8] John Jortin, *Remarks on Spenser's Poems* (1734), 77.

[9] *Circes of John Baptista Gello Florentine,* Translated out of Italian into English by Henry Iden (1557). Thomas Warton's suggestion was made in *Observations on the Fairy Queen of Spenser* (1762), II, 153.

[10] George Boas, *The Happy Beast* (Baltimore, 1933), 239.

an antimasque of beasts with "Grillus (of whom Plutarche writes in his moralles) in the shape of a hogge" bringing up the rear.

To those of Spenser's readers who regard his treatment of Plutarch's dialogue in Guyon's destruction of Acrasia's "Bowre of Bliss" as ultra-puritanical, its handling by the Italian, Ascanio Grandi, in his epic *Tancred* should be recommended. In that conventionally pious work the hero, armed with a sword containing a nail from the True Cross, listens even more coldly than Guyon does to a song of "Gather the Rosebuds" by the bathing nymphs of the enchantress Filidia.[11] Like Guyon, he proceeds at once to impose their lost humanity upon a drove of the witch's bestial lovers; but he finds himself involved in a debate with the most talkative of them and is overwhelmed with arguments in favor of life on the animal level which were first invented by Plutarch's Gryllus.[12] Seemingly Grandi intended the proofs to which Tancred is obliged to listen to strike the reader as utterly unconvincing, for Tancred's reply is as short as Guyon's answer to Spenser's Gryll. In the Italian epic the restoration of Filidia's rout of monsters to their human form seems even more arbitrary than the edifying disenchantment worked by Guyon and his Palmer on Acrasia's beasts. In the Italian epic, however, there is no Gryll, for the relic in Tancred's sword is irresistible.

Grandi, it is easy to say, misunderstood the spirit of Plutarch's dialogue as ridiculously as he did that of Homer's story of Circe. And if Grandi misunderstood Plutarch, what about Spenser? Is

[11] *Il Tancredi:* poema heroico del Sig. Ascanio Grandi al serenissimo Carlo Emanuele Duca di Savoia. Con gli argomenti del Sig. Giulio Cesare Grandi, fratello del autore (Lecce, 1632). In 1636 there was a second edition, and in 1867 the work was republished in the *Collana di opere . . . di scrittori di terra d'Otranto.* The following occurs in stanza 19 of canto VI:

Sta mane ora bambina, & hor che'l giorno
Giunto è al merigge, è giovane la Rosa:
E pria, che'l sole al mar faccia ritorno,
La rivedrai decrepita & odiosa:
NON hà, non hà l'età saldo soggiorno,
E par che piè non muova, e mai non posa:
Cogli tu'l fior de gli anni anzi, ch'ei cada,
Che invan sen pente poi chi a corlo bada.

[12] The spokesman of Filidia's beasts is the half-human bird, Vafrino, in whom Tancred recognizes a former retainer of his. When he becomes indignant the bird replies (V, 79):

Non minacciar col volto: huom più non sono:
Huom fui tuo servo, & a tuo prò ragiono.

his case not essentially like Grandi's, though perhaps less egregious? The answer must be in terms of the interpretation of Plutarch that prevailed in the Renaissance, but readers of the dialogue *Whether the Beasts have the Use of Reason* were as badly at odds in the fifteenth and sixteenth centuries as they are in the twentieth. By writers like Laurentius Valla and Machiavelli[13] the paradoxes of Plutarch's Gryllus were developed into what Professor Boas calls "intellectualist theriophily," or the more or less serious preference on brilliantly paradoxical grounds for the life of the brutes as compared with the human situation. The classic development of Plutarch's paradoxes seems to Professor Boas to occur in Montaigne's *Apology for Raymond Sebond*,[14] and he agrees with Professor Lovejoy in regarding Gelli's *Circe* as one of the channels transmitting the idea of "the superiority of the animals" from Plutarch to Montaigne and "a host of lesser writers."[15] On the whole, modern opinion in this country seems to incline toward this view of the matter and to approve Professor Lovejoy's inclusion

[13] There is no evidence that Spenser knew Machiavelli's *Asino d'oro*, where Ulysses converses in Dantean *terza rima* with a Circe who, though she is a kind of comic antitype of Beatrice, never quite commits herself to "theriophily." Machiavelli's unconvertible hog, however, is as cheeky as Spenser's Gryll, and roundly tells Ulysses that,

> Viver con voi io non voglio, e rifiuto;
> E veggo ben, che tu se' in quello errore,
> Che me più tempo ancor hebbe tenuto.

Niccolò Machiavelli, *Operette Satiriche*, ed. L. F. Benedetto (Turin, 1925), 110.

[14] Contrast Louis I. Bredvold's suggestion in *The Intellectual Milieu of John Dryden* (Ann Arbor, 1934), 30–1, that "Montaigne's easy and mundane reduction of men to the level of animals was not, except in tone, inharmonious with the Augustinian view of the depravity of man."

[15] A. O. Lovejoy and George Boas, *A Documentary History of Primitivism and Related Ideas* (Baltimore, 1935), I, 411. In interpreting Gelli's Circe as "theriophilous" Boas ignored Giovanni Gentile's opinion (in *Giordano Bruno e il pensiero del Rinascimento* [1925], 66) that the dialogue was intended as a paradoxical defence of the dignity of man as asserted by Pico della Mirandola. Theodore Spencer contrasts (*Shakespeare and the Nature of Man*, 36–8) Gelli with Montaigne, whose *Apology* he regards as challenging the view of St. Thomas that men who deny their absolute superiority to the brutes are guilty of heresy. To me it seems that Gelli's edifyingly ironical purpose is unmistakable in the contempt of his temperate rabbit for human temperance, and in the scorn of his medically educated serpent for human vices, etc. His real attitude is like that of Giordano Bruno in pouring unironical scorn upon the natural chastity of the hog in contrast with the reasonable chastity of men (in *Lo Spaccio della Bestia Trionfante*, *Opere Italiane*, II, *Dialoghi Morali*. Con note di Giovanni Gentile [1927], 153). Cf. note 37 *infra*.

of Plutarch's dialogue on the rationality of the brutes in his great collection of ancient primitivistic lore.

To humanists like Juan Luis Vives, on the other hand, Valla's interpretation of Plutarch's dialogue was extremely offensive. In the *De Anima* Vives reprobated the lengths to which Valla's passion for paradox had carried him in his development of Plutarch's playfully edifying dialectic. From "the declamatory style and manner" of the chat which Plutarch imagined between Ulysses and Gryllus on Circe's isle Vives argued that its apparent "theriophily" was far from serious. He looked at it as a satirical hoax written to edify men who are set apart from the beasts by the gift of reason. Vives spoke both as a humanist and as a dogmatic theologian, anxious to believe that the soul's possession of reason proves its divine origin and immortality; and he was indignant with Valla for daring to suggest that the beasts share at all in the rational nature of men.[16] This was the position of Catholic and Protestant divines alike, and even in the seventeenth century the stake of Christian orthodoxy in its defense brought much official support to Descartes' theory that animals are irrational automata. In Jerome Zanchius' Calvinistic treatise *De Operibus Dei* the opening chapter of the seventh book in Part II[17] formally denied that the beasts have the use of reason; while the chapter "Quanta sit hominis dignitas" defended[18] St. Paul's view of man as the temple of God on the ground that man's unique gift of reason made him a microcosm participating as much in divine reason as he does in animal sense.

Theology, however, must not bear more than its just share of blame for what we may call (parodying Dr. Boas's term "theriophilia") the theriophobia of Vives and Zanchius. Popular literature was full of a contempt for the brutes that was simply the obverse of the prevailing ethical dogma that virtue consisted in controlling the brutal in human nature. Although most humanists

[16] Juan Luis Vives, *Opera Omnia* (Valencia, 1782), III, 358.

[17] Jerome Zanchius, *De Operibus Dei intra Spacium sex dierum creatis opus* (1597), II, vii, 1, p. 596.

[18] *Ibid.*, III, ii, 1, p. 680. The passage ends by quoting from Gregory of Nyssa's *On the Creation of Man* (Book I, chapter 5): Quis (inquit) huius nobilitatem animalis digne admirabitur: quod in seipso immortalibus mortalia copulat, et rationalia irrationalibus colligat: in sui ipsius natura, totius creationis simulachrum ferens? Quibus de causis, etiam parvus mundus dictus qui tanta a Deo dignus factus est providentia.

were good enough Aristotelians to recognize the moral value of the passions, in the moralities and other popular allegories[19] they dramatized the conflict between them and reason in order to convince *l'homme moyen sensuel* that

> Unhallowed sense, . . .
> Being deadly drunk, makes still the worser choice,
> Wherein (like Sow in mire) it doth rejoice.[20]

When the humanists undertook the practical business of education, even the most liberal of them were apt to think in terms of the redemption of youth from the wiles of Circe when they were not thinking of their task, as Milton did, as that of repairing "the ruins of our first parents by regaining to know God aright."[21] So Erasmus, because he believed that "it is the possession of Reason that constitutes a man," and that "Reason, the mark of humanity, has no place where all is determined by appetite," bluntly asked the nobles whose undisciplined children he saw around him whether it would not "be a horror to look upon a human soul clad in the form of a beast, as Circe is fabled to have done by her spells? But is it not worse that a father should see his own image slowly but surely becoming the dwelling-place of a brute's nature?"[22]

From Erasmus' off-hand allusion to Circe we might get the impression that the enchantress and her beasts were familiar symbols, and perhaps were even a little stale. If we compare what Erasmus says with the typical treatments of Circe in the emblem books (which seldom failed to quote him), we find the impression of familiarity amazingly confirmed in a fashion that proves Circe's charm to have been proof against age's withering. In the typical woodcuts the enchantress sits surrounded by her beasts—a conventional seductress tyrannizing over willing slaves of passion. From the voluminous moralization of her myth that is appended earnest readers must have emerged less interested in the Homeric story of

[19] In "The Morality Theme in Book II of *The Faerie Queene*" (*Modern Language Notes*, XLVI, 371–9) Lewis F. Ball traces this theme in popular literature, particularly in Reason's own discussion of herself as she appears in *The Pilgrimage of the Life of Man*.

[20] John Davies of Hereford, *Microcosmos. The Discovery of a Little World* (1603), I, 23.

[21] *Of Education, Areopagitica, The Commonwealth*, edited by Laura E. Lockwood (Boston, 1911), 4.

[22] The passage is from *De Pueris Instituendis* as translated by W. H. Woodward in *Desiderius Erasmus concerning the Aims and Methods of Education* (London, 1904), 186–7.

Cauendum à meretricibus.

EMBLEMA LXXVI.

SOLE ſatæ Circes tam magna potentia fertur,
Verterit vt multos in noua monſtra viros.
Teſtis equum domitor Picus, tum Scylla biformis,
Atque Ithaci poſtquàm vna bibere ſues.
Indicat illuſtri meretricem nomine Circe,
Et rationem animi perdere, quiſquis amat.

Vlyſſei ſocij à Circe in bellua tranſformati.

HOmerus Odyſſeas x ait, ſocios aliquot Vlyſſis, qui miſſi ab eo fuerant exploraturi Circæas ædes, virga percuſſos à Circe, epotóque pharmacho venefico ſtatim in porcos eſſe transformatos. Quo figmento effingitur meretricis & libidinis fœdæ typus. Ea enim ſuis præſtigiis humanas illas cogitationes & naturales motiones (quæ ὁρμαὶ Græcis dicuntur) in homine tumultuantes viciat, & mutat in deterius, cùm ſcilicet in naturam quaſi belluinam abeunt. Per Vlyſſem autem qui nullo veneficio à priſtina forma dimoueri poteſt, mentem animæ ducem intelligimus. Quod ſic ad veterũ mythologorũ ſenſũ expreſſit vir induſtria & ingenio nulli penè ſecundus Eraſmus: Quid innuit Circes fabula, veneficiis homines verterntis in feras, niſi eos qui nequaquam ratione ducũtur id q*ui*.

Socij Vlyſſis

Omnia Andreae Alciati V. C. Emblemata: Cum Commentariis, etc. Per Claudium Divionensem (Paris, 1583, p. 263). Courtesy of the Henry E. Huntington Library.

Dosso Dossi's earlier Circe. In the Brown Collection, London.

Ulysses' adventure with the fairy mistress who turned his followers into swine than they were in its transformation by centuries of pagan[23] and Christian commentary into a kind of scripture on which rested the central article of their psychology and ethics. Entwined with the myth, coming down the centuries, they saw the doctrine which Cicero declared when he ended the *De Finibus* on the note that "the virtue of the mind outranks that of the body, and the voluntary virtues of the mind vanquish the involuntary virtues, because the former are born of reason, than which man can possess nothing more divine." The reading of such ethical content into the myth was, of course, known to be originally Platonic. "*Plato,* like a wise Philosopher," said Ascham in *The Scholemaster,*[24] warned against "licentious vanitie, that sweete and perilous poyson of all youth," just "as *Homere,* like a learned Poete, doth fayne, that *Circes,* by pleasant inchantmentes, did turne men into beastes, some into Swine, some into Asses, some into Foxes, some into Wolves, etc." That "*Homere* and *Plato* have both one meanyng, looke both to one end,"[25] Ascham thought that no one could doubt or dream of regretting.

Among the English humanists of the early sixteenth century there was no doubt or regret of Homer's 'Platonism.' Their faith in it was partly due to ignorance of Homer, or perhaps to indifference to the primeval Circe whom Ulysses outwitted, and loved, and abandoned. Their Circe was essentially the Circe of Servius' *Commentary on Virgil's Aeneid,* the "cruel goddess" who was called the daughter of the sun because her glitter persuaded men to abandon their human forms, and her songs deprived them of reason.[26] This was the Circe inherited by the early Florentine

[23] Paul Wölthers (in *Archäologisches Institut des Deutschen Reichs. Athenische Zweiganstalt.* Mitteilung 55, s. 231) in a study of some Etruscan vase-paintings which represent Circe's animal-headed rout as welcoming Ulysses very coldly, points out that this treatment of the myth was opposed to its allegorization in Heracleitus' *Homeric Allegories* and in general in the tradition that goes back to Socrates. Oscar Walzen (in *Vom Geistesleben alter und neuer Zeit* [1922], 46) points out the beginning of the Socratic tradition in Xenophon's *Memorabilia,* I, iii, 7, and its widespread development in Stoic thought.

[24] *English Works of Roger Ascham,* edited by William Aldis Wright (Cambridge, 1904), 226.

[25] Ibid., 227.

[26] *Publius Virgilius Maro, Opera* (Venice, 1492), CCV. Circe's songs, it is said, "Amittunt nam rationem; qua sola homines sumus; et ruunt in varias animi perturbationes; quae cum ex rationis privatione proveniunt, brutorum potius quam hominum dicendae sunt."

Neo-Platonists. In a commentary like that of Cristofero Landino[27] she is an embodiment of all the spiritual evil of the *dea saeva potentibus herbis*. Past her Aeaean island the fleet of Aeneas miraculously cruises in the moonlight, swept on by the winds of a friendly Neptune, which the commentator identifies with the leading of the divine spirit. English readers knew this Circe in Sir Thomas More's translation of Pico della Mirandola's letter to his nephew Gianfrancesco:

> There was sometime in Aeaea a woman called Circe, which by enchantment (as Virgil maketh mention) used with a drink to turn as many men as received it into divers likeness and figures of sundry beasts; some into lions, some into bears, some into swine, some into wolves, which afterward walked ever tame about her house, and waited upon her in such use or service as she list to put upon them. In like wise the flesh, if it make us drunk with the wine of voluptuous pleasure, or make the soul leave the noble use of his reason and incline unto sensuality and affections of the body: then the flesh changeth us from the figure of reasonable men into the likeness of unreasonable beasts, and that diversely: after the convenience and similitude between our sensual affections and the brutish properties of sundry beasts.[28]

Against this allegorical Circe it is easy to bring esthetic objections. If they seem serious or even unanswerable, it is well to remember that most of the Circes of the Renaissance were her daughters: Ariosto's Alcina, Trissino's Acratia, Tasso's Armida, as well as Spenser's Acrasia and even the not-entirely wicked enchantress of Giordano Bruno's *Cantus Circaeus*. In the hands of artists—poets, philosophers, or painters—she stood for more than the temptations of the flesh. So, clearly, she does in Dosso Dossi's early picture of her as a wilful young goddess teaching mysteries from her tablets to some beasts which are as ingenuously inquiring as the youths whom Bruno described in the *Cantus* as making their ardent spiritual pilgrimage to the Monte Circeo. Bruno's multiple allegory is evidently in part autobiographical, and its Circean figures represent the varying spiritual experience that lures and temporarily satisfies and ultimately disappoints men as they pass from youth's faith in the world's most respected institutions to the hard testing of their own private ideals in middle age. Perhaps we should see a somewhat comparable intention in Dossi's better-

[27] Christophoros Landinus, *Allegorie Platonicae in XII lib. Aeneidos* (Basileae, ex Officina Henriceptrina, 1577).

[28] *The English Works of Sir Thomas More*, Reproduced in facsimile by W. E. Campbell (London, 1931), I, 10–11.

known Circe which now hangs in the Borghese palace in Rome. There the witch sits dressed in eastern robes among her enchanted beasts and seems to symbolize all the strange goddesses as well as the strange women who have beguiled the romantic hearts of men. She is, as the late Bernard Berenson pointed out,[29] a Saracen sorceress, and before her "we lose ourselves in a maze of strange lights and mysterious colors which make us sink deeper and deeper into a world . . . as entrancing as it is far away. Marlowe and Shakespeare, Mr. Berenson thought, "would have taken that delight in her which we can well imagine that Ariosto took."

Mr. Berenson did not compare Ariosto's Alcina with Dossi's Circe, but his suggestion should interest readers familiar with Fornari's interpretation of Ariosto's enchantress as representing the Mohammedan (or Jewish) religion.[30] The suggestion vaguely supports the commentator's effort to supercharge Alcina with a trace of politico-theological significance; and so, through Ariosto, it may relate Dossi's picture to Spenser's allegory in the second book of *The Faerie Queene* if, like the late Professor Greenlaw,[31] we interpret Acrasia as having a political as well as a privately ethical meaning. Certainly in Ariosto's obvious allegory Alcina represents incontinence or excess, but in her love-affairs with Astolfo and Ruggiero she becomes a kind of Cleopatra. Her Ortygian palace, which is reached by the hippogriff in a flight to some strange spot in the eastern Mediterranean, is both a place where East meets West and where Youth meets enchantment. It is somewhere in the geographical as well as in the allegorical neighborhood of the enchanted island of Egnotia in Trissino's *Italia Liberata dei*

[29] Bernard Berenson, *The Study and Criticism of Italian Art* (Second edition, 1903), 31–2. Berenson evidently was not impressed by Julius von Schlosser's suggestion (*Vermutung*) in *Jahrbuch der preussischen Kunstsammlungen,* XXI (1900), 268–9, that the Borghese portrait represents Ariosto's Melissa in *Orlando Furioso,* VIII, 14–5. My colleague, Professor Oskar Hagen, who refers me to von Schlosser, suggests that the earlier Circe also represents some Circean witch later than Homer's. To me the suggestion that the Borghese figure represents the very un-Circean Melissa does not seem convincing.

[30] Simone Fornari, *Spositione sopra l'Orlando Furioso di M. Ludovico Ariosto* (Florence, 1549). Fornari's treatment of cantos v and vi of the *Orlando* is noticed in connection with the Medina incident in *The Faerie Queene,* II, ii, by Miss S. J. McMurphy in *Spenser's Use of Ariosto for Allegory* (University of Washington Publications in Language and Literature, II [1934], 26).

[31] Edwin Greenlaw, *Studies in Spenser's Historical Allegory* (Baltimore, 1932), 93–5.

Goti. Trissino's sorceress has an even more definite political significance than Ariosto's Alcina or Tasso's Armida. In the liberation of Arete (Virtue), who is a prisoner in Egnotia to Trissino's Acratia, and in the restoration to human form of the crowd of beastly lovers whom she has seduced from the army of the Goths, the political allegory is patent. In Ariosto's Alcina and in Spenser's Acrasia it is so veiled that it is clear only to readers who are steeped both in the connotations of the Circe myth and of the Aristotelian conception of ἀκρασία or incontinence.[32]

The name Acrasia—which simply personifies a term central to the discussion of vice and virtue in the opening chapters of the seventh book of the *Nicomachean Ethics*—indicates that Spenser (like Trissino) at least intended to make his Circe in part a reflection of the human weakness that Aristotle contrasted with self-control (ἐγκράτεια). Spenser's inheritance from Aristotle has been variously analyzed by several scholars, but it is to Professor Jones[33] that we owe the best historical account of the fusion of medieval Aristotelianism with the Neo-Platonism of *The Faerie Queene.* He reminds us of Aristotle's view of human consciousness as "a sliding scale, which at one time seems to identify (man) with the divine spirit, and at another with the very flesh of his body. The rift that runs through the philosophy of Plato," we are reminded, widens in Aristotle "till it rends human nature asunder."[34] Stress upon this "rift" in human nature seems to us much more characteristic of Platonism than of Aristotelianism, but—as Caird pointed out—its Aristotelian phase played a great rôle in Scholastic theology. At the root of the distinction between the contemplative and the active life in the Thomist tradition lay Aristotle's doctrine that the men whom the gods love best are those "whose activity is directed by reason. For if the gods care at all for human things, as it is believed, it will be only reasonable to hold that they delight in what is best and most related to themselves, i.e., to reason."[35] On the strength of this aspect of Aristotle's ethics the Florentine Neo-Platonists, we should remember, regarded themselves as no

[32] See F. M. Padelford, "The Virtue of Temperance in *The Faerie Queene*," *Studies in Philology,* XVIII, 334–46.

[33] H. S. V. Jones, "*The Faerie Queene* and the Mediaeval Aristotelian Tradition," *Journal of English and Germanic Philology,* XXV, 283–298.

[34] Quoted by Jones (289) from Edward Caird's *The Evolution of Theology in the Greek Philosophers,* 313–4.

[35] *Nicomachean Ethics,* X, viii, 13.

less Aristotelian than they were Platonic.[36] And for the purpose of the present study it is of the first importance—as well as of curious interest—to understand that the Florentines combined the doctrine of the "rift" in human nature with another doctrine that they rightly regarded as having the authority of both Plato and Aristotle behind it: the doctrine of the great chain of being and of microcosmic man.

As clear a statement of the "chain" and of the theory of man as a microcosm as the literature of the Renaissance affords is made in the *De Voluptate* of Marsilio Ficino. In his hands the great principle that creation stretches down by unbroken links from God to formless matter, and that man is a microcosm precisely at the centre of the chain, became an instrument to whip men into fear of the brutal elements in themselves, and to spur them into love of the divine. There may seem to have been no logical reason why the microcosmic theory of man should not have made Ficino more tolerant than he was of our animal nature, nor why it should not have daunted the theologians who fixed a gulf between human reason and all consciousness on animal levels. And in fact—at least as early as the time when Dante wrote the *Convito*[37]—theologians had had to struggle with the heresy that "the most perfect soul belonging to the brutes" differs hardly perceptibly from the worst human soul, just as the best human soul reaches virtually to the level of the lowest of the angels. In the sixteenth century, with the appearance of scientific minds like those of Pietro Pomponazzi and Bernardino Telesio, the distinction between human reason and animal reaction to sense impressions was seriously challenged. Telesio, who made "sense the basis of all knowledge," as Profes-

[36] In *De Voluptate* (1497, sig. Ziiii^{r}) Ficino quoted Aristotle's classification of the pleasures as contemplative, executive (or relating to successful prosecution of work), and physical or sensual. Indulgence in the first, Ficino recalled that Aristotle had said, made men divine; indulgence in the second made them human; while indulgence in the third made them bestial. Subsequently (sig. Ziiiii^{r}) he quoted Plato on incontinence as bestial indulgence in the pleasures of sense. Similarly Gianfrancesco Pico della Mirandola in *On the Imagination* (translated by Harry Caplan [1930], 39) quoted Aristotle's *Physics* to show that, because animals "live on memories and imaginations" and "possess nothing nobler than this imaginative power," they are cut off from the human gift of reason.

[37] Richard Holbrook, in *Dante and the Animal Kingdom* (1902), 82, regarded this passage in the *Convito* as distinctly heretical in its view that the "most perfect soul belonging to the brutes" differs hardly at all from the worst human soul, just as the best human soul is hardly distinguishable from the least of the angels.

sor Spencer has pointed out, was confident that "the difference between the knowledge possible to man and the knowledge possible to animals was merely a difference of degree and not a difference of kind, and that what we call reason is but a refinement of sense, so that 'the perceptive faculty, which seems to be proper to the human soul and is called rational, . . . has manifestly been bestowed upon the souls of all other animals.' "[38] Thinking of this sort, it might be supposed, would have undermined the doctrine of the cosmic chain of being and of microcosmic man, but even among the most "scientific" thinkers of the sixteenth and seventeenth centuries its effect was hardly that. On the contrary, it often helped to confirm the habit of looking for animal characteristics in human behavior and of making practical morality consist in their control. If the distinction between men and brutes was not absolute, and if human reason was not an essentially divine faculty, then men might only too easily lapse to brutal levels in conduct and even in character, and so—in simple though marvellous reality—Homer's myth of Circe might assume a truly "scientific" as well as "historical" validity.

For some of the leading physicians and philosophers of the Renaissance as well as for some of its Homeric scholars and theologians the myth did assume just that kind of validity. In the first quarter of the sixteenth century Pomponazzi interpreted the myth of Circe and her beasts essentially as Spenser did, and he related it—with the imagination of a scientist rather than of a metaphysician—to his life-long effort to relate man to "nature, and especially to forms of life below him in the scale of being."[39] In Pomponazzi's thinking it is perhaps justifiable to recognize "an early beginning of the comparative and historical method . . . by which an intelligible account of man is substituted for dogmatic conceptions alike of body and soul." In Professor Lovejoy's *Great Chain of Being* Pomponazzi is not mentioned, and the evolutionary and psychological interest of the microcosmic view of man in a writer like Francis Bacon is hardly touched. Though Bacon was critical of the doctrine, he definitely accepted it. "The chymiques," he said,[40] had too "curiously" taken the "elegancy

[38] Theodore Spencer, *Shakespeare and the Nature of Man* (New York, 1942), 32–3.

[39] Andrew Douglas, *Pietro Pomponazzi* (1910), 113.

[40] *The Wisedome of the Ancients,* Written in Latine By the Right Honourable Sir Francis Bacon Knight. . . . Done into English by Sir Arthur Gorges Knight

of this word (microcosm) to the letter, contending to find in men all minerals, all vegetables and the rest''; yet Bacon's imagination responded to the doctrine and he made it the basis of a psychology very like Spenser's in the second book of *The Faerie Queene.* When all allowance had been made for its fantastic exaggerations, Bacon still believed that ''the body of man, like all material things, is found to be most compounded and most organical, whereby it is endued and furnished with most admirable virtues and faculties.'' The implications of this view emerge more fully in the theory of the Frenchman, Marin Cureau de la Chambre, that the microcosmic conception of man as transcending all other animals by uniting all their qualities together with those of the vegetable and mineral worlds in his single nature, should terminate in the principle that man's humanity itself consisted in maintaining the delicate physical and moral equilibrium of his components. In themselves, Marin Cureau believed, ''the inclinations . . . which men may have, though they might be for the most excellent virtues, are imperfections; . . . And this is that which the Angel of the Schools hath so judiciously delivered, when he affirmed that there is no animal but hath some inclination to a passion conformable to his nature; but that man only is the mean of all, and that it is requisite he should be equally susceptible thereof, inasmuch as he is, of his own nature, indifferent and indeterminate.''[41] So in Cureau's view of human nature as essentially a physical, psychological and ethical mean support was found for that ultimately Aristotelian conception of virtue as a mean between extremes which the second book of *The Faerie Queene* professed to take over from the *Nicomachean Ethics.* As a microcosm all compact of animal passions, man could hope to be human only by achieving balance or ''mediocrity'' among all his opposed brutal inclinations with the help of his peculiarly human reason.

This theory was interestingly supported by what seemed in the Renaissance to be the soundly scientific doctrines of the physiognomists. Most of them, like Giovanni della Porta, prided themselves on using Aristotle's ''syllogistical method'' of divining the mind's

(1619), 126–7. Spedding (in his edition of *The Literary and Professional Works of Sir Francis Bacon* [1858], I, 607) dated the first edition in 1609, but placed the composition of some of the fables before 1605.

[41] Marin Cureau de la Chambre, *The Art How to Know Men,* Originally Written by the Sieur de la Chambre, Councillor to His Majesty of France, and Physician in Ordinary. Rendered into English by John Davies of Kidwelly (1665), 159.

construction in the face. In his work *On Human Physiognomy* Della Porta made much of the "syllogistical" comparison of specific physical with corresponding psychological traits to show, for instance, that the large extremities of lions are characteristic also of brave men and of all courageous creatures. In practice, however, his use of rough sketches of human faces flanked by more or less corresponding animal ones must have done less to educate his readers to discriminate among various physical traits and their supposed psychological counterparts than it did to confirm the popular habit of associating certain animals with certain vices, and of imputing those vices to men with features at all suggestive of the respective brutes. After finding the same piggish face beside the same swine's snout for the sixth time, the reader could hardly be blamed if he was more impressed by the general hoggishness of the human features than he was by their "syllogistically" analyzed resemblance to isolated traits of the hog—the nose in one instance, the eyes in another, etc. Perusal of the entire work would surely incline him to agree with Della Porta when he wrote that Plutarch did no violence to the facts in his dialogue on the rationality of the animals in representing Ulysses as easily identifying his transformed followers by recognizing in the beasts into which they had turned simply the natural developments from the vices for which they had respectively been notorious as men. The charms of Circe had simply made their moral nature express itself in their physical bodies.[42]

If Spenser's readers were familiar with physiognomical theories, they could hardly look into Homer or Plutarch without wondering whether, by some natural or supernatural law, men might not be transformable into beasts. If that possibility interested them, they could pursue it into various discussions of lycanthropy by medical authorities, some of whom referred to the Homeric account of Circe and wavered between accepting it as history and discounting it as allegory. Theological writers, especially those with any interest in witchcraft, were ready to accept the story literally, as Jean Bodin did in his *Demonology*. Dealing

[42] The edition of Ioannis Baptistae Portae *De Humana Physiognomonia* which I have consulted is that published in Hanover in 1593. The first edition was in 1586. Professor Ruth Wallerstein refers me to Thomas Campanella's *De Sensu Rerum et Magia* (Paris, 1637), Book II, chapter 23, where the distinction between men and beasts is declared to be relative. In chapter 27 human participation in bestial traits is recognized as the basis of "syllogistic" physiognomy.

with lycanthropy in connection with the power of witches to impose animal forms upon their victims, Bodin twisted the authority of men as unlike as Pomponazzi and Paracelsus into support of such transformations.[43] For Bodin, Circe was a veritable witch, and disbelief of her metamorphosis of Ulysses' men into beasts amounted to impious scepticism. He condemned the Fathers of the Church who, like St. Chrysostom, treated the beasts of Circe as allegorical, and he disapproved of St. Augustine's undogmatic treatment of the Circe story in *The City of God*. His final appeal was to St. Thomas Aquinas, in whose doctrine that the demons can impose any shape at will upon men it was possible, by regarding Circe as a witch in league with Satan, to rationalize the Homeric myth theologically and also to preserve it as history.

Bodin's influence is attested by Reginald Scot's attacks on his interpretation of Circe and her beasts. Point by point, Scot's *Discovery of Witchcraft* challenges Bodin's notion of Circe as an enchantress. It replies to his medical evidence on the score of lycanthropy; it refuses to take seriously the verses of the poets who "(whether in jest or ernest) ascribe unto witches and to their charms more than is to be found in human or diabolical power"; and it laughs at "the metamorphosis or transubstantiation of Ulysses his companions into swine, which St. Augustine and so many great clerks credit and report."[44]

On the available evidence it is hard to tell how educated men divided in this quarrel. The faith of the Homeric editor,[45] Jean de Sponde, in Circe as "a most potent witch" forbids us to think that only the ignorant and the fanatical sided with Bodin. Following the *Demonomanie* step by step, de Sponde regretted St. Augus-

[43] Jean Bodin, *De la Demonomanie des Sorciers* (Paris, 1580). In Book II, chapter 6, "De la lycanthropie et si le Diable peut changer les hommes en bestes," Bodin recalled (98) that "Pomponatius et Théophraste Paracelse des premiers philosophes de leur age, tiennent que la transmutation est très certaine d'hommes en bestes."

[44] Reginald Scot, *A Discoverie of Witchcraft* (1584), 130.

[45] *Homeri quae extant omnia, Ilias, Odyssea, Batramyomachia, Hymni, Poemata aliquot.* . . . Perpetuis idem iustisque in Iliada simul at Odysseam Ioannis Spondani Mauleonensis Commentariis (Basle, 1583), 137: "In primus hoc statuo, Circem magam fuisse praestantissimam, cui omnia venena fuerint notissima, insuper etiam radicum herbarumque vires perspectissimae: adderem etiam fuisse illam Diabolo magistro et praeceptore usam, etc. . . . Putas hoc temere de Circe scriptum sine ulla ratione. Scio poetis familiare esse fabulosa scribere; hoc tamen fabulosum dici posse ego constanter pernego."

tine's uncertainty about the literal transformation of Ulysses' men, quoted St. Thomas on the power of demons to change men at least into the semblances of beasts, and renewed Bodin's distinction between such authentic miracles and the self-delusions of the victims of lycanthropy. Finally de Sponde asked his readers whether all that the poets had written about Circe could be sheer fiction, and solemnly denied that such serious writers could have trifled with the facts of the matter.

Perhaps in the sixteenth century belief in Circe's transformations was too much involved in theology, pseudo-science, and folklore for even educated men to be contemptuous of de Sponde's faith in them. Theologians were bound to believe in them, for denial was equivalent to doubt of the power of witchcraft itself, and such doubt was heresy. Their position was well stated by Jerome Zanchius in his chapter "On the strength and power of the demons." There he interpreted St. Augustine's noncommittal remarks about Circe's transformations as a downright profession of belief in the diabolic miracle, and he brought the poets and historians generally to support Homer's testimony to the fiendish wizardry which he held might still change men into the semblance, if not into the substance, of beasts.[46]

Bodin's conception of the Homeric Circe can hardly have been unknown to Spenser, and it may have been as salient a part of his total view of her as was Plutarch's treatment of her and her victims in the dialogue *Whether the Beasts Have the Use of Reason.* However much or little he was influenced by either writer, he must have known that many of his readers would have been influenced by them both. He must have known also that many of them were interested in the psychological rationalizations of her myth by mythographers like Natale Conti.[47] Professor Lemmi has shown[48] that Spenser implies "a correspondence between the various forms of Acrasia's victims and various kinds of depravity." He parallels Conti's account of the followers of Ulysses in the *Odyssey* as having been transformed "according to the nature of the vice each was inclined to, into various sorts of brutes. The libidinous become hogs, the choleric bears, and so on." It is not likely, however,

[46] *De Operibus Dei,* Part I, Book IV, Chapter 10, 245.

[47] Natale Conti's *Mythologiae, sive explicationis fabulorum libri decem* was first published in 1551. The edition used here is that published in Frankfurt in 1596.

[48] C. W. Lemmi, "The Symbolism of the Classical Episodes in *The Faerie Queene,*" *Philological Quarterly,* VIII, 279.

that Spenser owed this element in his allegory to even so influential a handbook as Conti's. He found it everywhere; in Homeric criticism, in the physiognomists, and in the psychology of the Italian Neo-Platonists. He found it in Ariosto's half-human monsters, Alcina's lovers, who are described as having been metamorphosed, some into monkeys, others into goat-footed creatures, others into centaurs, etc.[49] In Fornari's commentary on the *Orlando Furioso* these biform creatures represent various vices or their victims—the distinction seems to be made intentionally imperfect: the goat-footed embody lust, the centaurs, violence, etc.[50] In Fornari's vaguely Neo-Platonic scheme of the universe microcosmic man was forever in danger from the bestial elements within him of falling into some outward, bestial metamorphosis.

It has been the purpose of this study to indicate that Spenser's conception of Circe and her beasts had a background wider than any single literary source, such as Ariosto, Plutarch, or Homer; and wider than Neo-Platonism or any other single philosophical system. The beasts, we may be sure, he regarded much as Conti did. He thought of them as essentially (in Conti's language) "faculties of the mind conspiring with the body's affections and breaking their harmony with reason." For Conti—as for many interpreters of the sun's daughter as far back as Plutarch—Circe was both a physical and a moral symbol. She was, he said, the *libido* which drives the elements through the eternal process of birth and decay; but in man she was the *libido* which, unless reason prevents, transforms the delicately balanced microcosm, as poets feign, into various beasts; the lustful into hogs, the wrathful into lions, etc. Conti forgot that in the *Odyssey* the Circe story is an episode. All the way through the action of that epic he saw the sorceress working as an all-pervading demonic force opposing the divinely-led incarnation of Reason, Ulysses. Wherever lust or violence deforms any of the Greeks, Conti recognized the malign influence of Circe as at work. In the adventures with the Cyclops and with the winds of Aeolus, and of course in the myth of Scylla, whom one version said that Circe had metamorphosed, he saw Circe's fine hand at work as plainly as Spenser advertised Acrasia's hand as responsible for Mordaunt's metamorphosis at the beginning of Guyon's crusade against that enchantress. Indeed, as the

[49] *Orlando Furioso*, Canto VI, stanza 61.

[50] *Orlando Furioso* di Ludovico Ariosto secondo l'edizione del 1532. Con commento di Pietro Papini (1903), 7, note 61.

Odyssey is interpreted by Conti, the entire epic becomes as much of a crusade against a "wicked witch" as is the second book of *The Faerie Queene.*

The likeness which is suggested here between Conti's commentary on the Circe myth and Spenser's allegory of Acrasia is more far-reaching, though less specific and dogmatic, than that which has been pointed out by Professor Lemmi. It amounts to hardly more than the view that the Elizabethans would, thanks to Conti and other writers in many fields, have been prepared to see more structural and imaginative unity than we do in the second book of *The Faerie Queene.* In Conti's reminder that the myth of the sun's daughter represented all the sensory and imaginative illusion in the eternal process of birth and death we may see reason for regarding the monsters of the last four cantos of Spenser's Legend of Temperance as psychologically consistent and interesting. As the enchantress responsible for those evidently illusory beings, Acrasia stood for something more complex than mere physical lust—for something quite as complex indeed as that disease of the whole sensual nature which Mr. C. S. Lewis sees in her languid pleasure with Verdant.[51] In only her most obvious symbolism is she the sexual excess which Ariosto's Alcina represents. Though the beasts in her garden were

> "Whylome her lovers, which her lusts did feed,"[52]

passion has not played the only part in their seduction. Acrasia's beasts, like Circe's in many Renaissance treatments of her myth, are monsters of various kinds.

> "According to their minds like Monstruous."[53]

Guyon meets them in an enchanted landscape like that in the youthful Dosso Dossi's symbolic picture of the nude Circe reading charms that are deeper than sex to her diverse menagerie. The landscape in that picture is no more a bit of Italy than it is of any realm where the Circes of the Renaissance could impose their illusions on knights who—like Astolfo or Ruggiero in Fornari's allegory—represent ideally "temperate and continent characters."[54]

[51] *The Allegory of Love,* 332.

[52] *The Faerie Queene,* II, xii, 85, 3.

[53] *The Faerie Queene,* II, xii, 85, 5.

[54] "Per Astolfo e per Ruggiero, che da l'Isola d'Alcina si riducono a Logistilla, viene allegoricamente compresa la natura dell'huomo temperato et del continente." Porcacchi's note in the *Orlando Furioso* (Venice, 1617), 26.

The symbolic interest of the enchantress corresponds to that of her victims. If in part Guyon stands for the political aspect of the virtue of temperance, then Professor Greenlaw was right in treating Acrasia as in part a symbol of political evil. If, as Professor Padelford contended, Guyon is an embodiment of Aristotle's highly civilized virtue of continence, then Acrasia represents all that endangers that highly sophisticated ethical ideal.

As "background," if not as "influence," all the Circes of the Renaissance illuminate Spenser's Acrasia. Of them all, the Circes of Bruno's *Cantus Circaeus* and *De gli Eroici Furori* are least like her. Spenser's witch is a rich but essentially traditional figure; for Bruno Circe was a deeply realized symbol of inner experience, standing less for the illusion that the material world works on the senses and passions than for the still more painful inner illusions of the spirit. Spenser's practical, ethical objects in the Legend of Temperance prevented Acrasia from being the more profound psychological symbol of Bruno's disillusion with both evil and good, or with all except the very best that passes for good in the spiritual world. For the same reason Acrasia has nothing in common with the morally neutral Circe of Montaigne, who is simply the force that by working diversely in every individual shapes every character.[55] Montaigne's Circe is only a passing thought in his essay "Of Experience," a personal reflection upon the traditionally maligned enchantress; yet Montaigne recognized her also as a symbol of the tragic fixation of character by life. In *The Faerie Queene* Acrasia could not symbolize what Circe did for either Bruno or Montaigne; yet, when Spenser is condemned by critics who resent the destruction of the Bower of Bliss, it is worth remembering that Bruno's sense of the universality and beauty of the things for which Circe stood did not prevent him from cursing her. And what else are Guyon's final words to Gryll in Acrasia's garden but a bitter statement of Montaigne's observation on Circe's tragic power to determine character?

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[55] *The Essays of Montaigne,* done into English by John Florio (London, 1893), III, 347.

GALILEO AND PLATO

By Alexandre Koyré

The name of Galileo Galilei is indissolubly linked with the scientific revolution of the sixteenth century, one of the profoundest, if not the most profound, revolution of human thought since the invention of the Cosmos by Greek thought: a revolution which implies a radical intellectual "mutation," of which modern physical science is at once the expression and the fruit.[1]

This revolution is sometimes characterized, and at the same time explained, as a kind of spiritual upheaval, an utter transformation of the whole fundamental attitude of the human mind; the active life, the *vita activa* taking the place of the θεωρία, the *vita contemplativa,* which until then had been considered its highest form. Modern man seeks the domination of nature, whereas medieval or ancient man attempted above all its contemplation. The mechanistic trend of classical physics—of the Galilean, Cartesian, Hobbesian physics, *scientia activa, operativa,* which was to render man "master and possessor of nature"—has, therefore, to be explained by this desire to dominate, to act; it has to be considered purely and simply an outflow of this attitude, an application to nature of the categories of thinking of *homo faber.*[2] The science of Descartes—and *a fortiori* that of Galileo—is nothing else than (as has been said) the science of the craftsman or of the engineer.[3]

I must confess that I do not believe this explanation to be entirely correct. It is true, of course, that modern philosophy, as well as modern ethics and modern religion, lays much more stress on action, on πράξις, than ancient and medieval thought. And it is just as true of modern science: I am thinking of the Cartesian physics and its analogies of pulleys, strings and levers. Still the attitude we have just described is much more that of Bacon—whose

[1] Cf. J. H. Randall, Jr., *The Making of the Modern Mind* (Boston, 1926), 220 sq., 231 sq.; cf. also A. N. Whitehead, *Science and the Modern World* (New York, 1925).

[2] This widespread conception must not be confused with that of Bergson, for whom all physics, the Aristotelian just as much as the Newtonian, is in the last analysis the work of *homo faber.*

[3] Cf. L. Labertonnière, *Études sur Descartes* (Paris, 1935), II, 288 sq.; 297; 304: "physique de l'exploitation des choses."

rôle in the history of science is not of the same order[4]—than that of Galileo or Descartes. Their science is made not by engineers or craftsmen, but by men who seldom built or made anything more real than a theory.[5] The new ballistics was made not by artificers and gunners, but against them. And Galileo did not learn *his* business from people who toiled in the arsenals and shipyards of Venice. Quite the contrary: he taught them *theirs*.[6] Moreover, this theory explains too much and too little. It explains the tremendous scientific progress of the seventeenth century by that of technology. And yet the latter was infinitely less conspicuous than the former. Besides, it forgets the technological achievements of the Middle Ages. It neglects the lust for power and wealth which, throughout its history, inspired alchemy.

Other scholars have insisted on the Galilean fight against authority, against tradition, especially against that of Aristotle:

[4] Bacon is the announcer, the *buccinator* of modern science, not one of its creators.

[5] The Cartesian and Galilean science has, of course, been of extreme importance for the engineer and the technician; ultimately it has produced a technical revolution. Yet it was created and developed neither by engineers nor technicians, but by theorists and philosophers.

[6] "Descartes artisan" is the conception of Cartesianism developed by Leroy in his *Descartes social* (Paris, 1931), and brought to absurdity by F. Borkenau in his book *Der Uebergang vom feudalen zum bürgerlichen Weltbild* (Paris, 1934). Borkenau explains the birth of the Cartesian philosophy and science by that of a new form of economic enterprise, i.e., manufacturing. Cf. the criticism of the work of Borkenau, a criticism much more interesting and instructive than the book itself, by H. Grossmann, "Die gesellschaftlichen Grundlagen der mechanistischen Philosophie und die Manufaktur," *Zeitschrift für Sozialforschung* (Paris, 1935).

As for Galileo, he is linked with the traditions of the artisans, builders, engineers, etc., of the Renaissance by L. Olschki, *Galileo und seine Zeit* (Halle, 1927), and more recently by E. Zilsel, "The Sociological Roots of Science," *The American Journal of Sociology*, XLVII (1942). Zilsel stresses the rôle played by the "superior artisans" of the Renaissance in the development of the modern scientific mentality. It is, of course, perfectly true that the artists, engineers, architects, etc., of the Renaissance played an important part in the struggle against the Aristotelian tradition, and that some of them—like Leonardo da Vinci and Benedetti—attempted even to develop a new, anti-Aristotelian dynamics; yet this dynamics, as was conclusively shown by Duhem, was in its main features that of the Parisian nominalists, the *impetus* dynamics of John Buridan and Nicole Oresme. And if Benedetti, by far the most remarkable of these "forerunners" of Galileo, transcends sometimes the level of the "Parisian" dynamics, it is not because of his work as engineer and gunner but because of his study of Archimedes and his decision to apply "mathematical philosophy" to the investigation of nature.

against the scientific and philosophical tradition, upheld by the Church and taught in the universities. They have stressed the rôle of observation and experience in the new science of nature.[7] It is perfectly true, of course, that observation and experimentation form one of the most characteristic features of modern science. It is certain that in the writings of Galileo we find innumerable appeals to observation and to experience, and bitter irony toward men who didn't believe their eyes because what they saw was contrary to the teaching of the authorities, or, even worse, who (like Cremonini) did not want to look through Galileo's telescope for fear of seeing something which would contradict their traditional theories and beliefs. It is obvious that it was just by building a telescope and by looking through it, by careful observation of the moon and the planets, by his discovery of the satellites of Jupiter, that Galileo dealt a crushing blow to the astronomy and the cosmology of his times.

Still one must not forget that observation and experience, in the sense of brute, common-sense experience, did not play a major rôle—or, if it did, it was a negative one, the rôle of obstacle—in the foundation of modern science.[8] The physics of Aristotle, and even more that of the Parisian Nominalists, of Buridan and Nicole Oresme, was, as stated by Tannery and Duhem, much nearer to common sense experience than those of Galileo and Descartes.[9]

[7] Quite recently a friendly critic has reproached me for having neglected this side of Galileo's teaching. (Cf. L. Olschki, "The Scientific Personality of Galileo," *Bulletin of the History of Medicine*, XII [1942].) I must confess I do not believe I have merited this reproach, though I do indeed believe that science is primarily theory and not the gathering of "facts."

[8] É. Meyerson, *Identité et réalité*, 3 ed. (Paris, 1926), 156, shows very convincingly the lack of accord between "experience" and the principles of modern physics.

[9] P. Duhem, *Le Système du Monde* (Paris, 1913), I, 194 sq.: "Cette dynamique, en effet, semble s'adapter si heureusement aux observations courantes qu'elle ne pouvait manquer de s'imposer, tout d'abord, à l'acceptation des premiers qui aient spéculé sur les forces et les mouvements. . . . Pour que les physiciens en viennent à rejeter la Dynamique d'Aristote et à construire la Dynamique moderne, il leur faudra comprendre que les faits dont ils sont chaque jour les témoins ne sont aucunement les faits simples, élémentaires, auxquelles les lois fondamentales de la Dynamique se doivent immédiatement appliquer; que la marche du navire tiré par les haleurs, que le roulement sur une route de la voiture attelée doivent être regardés comme des mouvements d'une extrême complexité; en un mot que pour le principe de la science du mouvement, on doit, par abstraction, considérer un mobile qui, sous l'action d'une force unique, se meut dans le vide. Or, de sa Dynamique Aristote va jusqu'à conclure qu'un tel mouvement est impossible."

It is not "experience," but "experiment," which played—but only later—a great positive rôle. Experimentation is the methodical interrogation of nature, an interrogation which presupposes and implies a *language* in which to formulate the questions, and a dictionary which enables us to read and to interpret the answers. For Galileo, as we know well, it was in curves and circles and triangles, in mathematical or even more precisely, in *geometrical language*—not in the language of common sense or in that of pure symbols—that we must speak to Nature and receive her answers. Yet obviously the choice of the language, the decision to employ it, could not be determined by the experience which its use was to make possible. It had to come from other sources.

Still other historians of science and philosophy[10] have more modestly tried to characterize modern physics, as *physics*, by some of its salient traits: for instance, by the rôle which the principle of *inertia* plays in it. Perfectly right, once more: the principle of *inertia*, in contradistinction to that of the Ancients, holds an outstanding place in classical mechanics. It is its fundamental law of motion; it implicitly pervades Galilean physics and quite explicitly that of Descartes and of Newton. But this characteristic seems to me to be somewhat superficial. In my opinion it is not enough simply to state the fact. We have to understand and to explain it—to explain why *modern* physics was able to adopt this principle; to understand why, and how, the principle of inertial motion, which to us appears so simple, so clear, so plausible and even self-evident, acquired this status of self-evidence and *a priori* truth whereas for the Greeks as well as for the thinkers of the Middle Ages the idea that a body once put in motion will continue to move forever, appeared as obviously and evidently false, and even absurd.[11]

I shall not try to explain here the reasons and causes that produced the spiritual revolution of the sixteenth century. It is for our purpose sufficient to describe it, to describe the mental or intellectual attitude of modern science by two (connected) characteristics. They are: 1) the destruction of the Cosmos, and therefore

[10] Cf. Kurd Lasswitz, *Geschichte der Atomistik* (Hamburg und Leipzig, 1890), II, 23 sq.; E. Mach, *Die Mechanik in ihrer Entwicklung*, 8 ed. (Leipzig, 1921), 117 sq.; E. Wohlwill, "Die Entdeckung des Beharrunggesetzes," *Zeitschrift für Völkerpsychologie und Sprachwissenschaft*, vols. XIV and XV (1883 and 1884), and E. Cassirer, *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit*, 2 ed. (Berlin, 1911), I, 394 sq.

[11] Cf. É. Meyerson, *op. cit.*, 124 sq.

the disappearance in science of all considerations based on that notion;[12] 2) the geometrization of space—that is, the substitution of the homogeneous and abstract space of Euclidian geometry for the qualitatively differentiated and concrete world-space conception of the pre-galilean physics. These two characteristics may be summed up and expressed as follows: the mathematization (geometrization) of nature and, therefore, the mathematization (geometrization) of science.

The dissolution of the Cosmos means the destruction of the idea of a hierarchically-ordered finite world-structure, of the idea of a qualitatively and ontologically differentiated world, and its replacement by that of an open, indefinite and even infinite universe, united and governed by the same universal laws; a universe in which, in contradiction to the traditional conception with its distinction and opposition of the two worlds of Heaven and of Earth, all things are on the same level of Being. The laws of Heaven and the laws of Earth are merged together. Astronomy and physics become interdependent, and even unified and united.[13] And this implies the disappearance from the scientific outlook of all considerations based on value, on perfection, on harmony, on meaning and on purpose.[14] They disappear in the infinite space of the new Universe. It is in this new Universe, in this new world of a geometry made real, that the laws of classical physics are valid and find their application.

The dissolution of the Cosmos—I repeat what I have already said: this seems to me to be the most profound revolution achieved or suffered by the human mind since the invention of the Cosmos by the Greeks. It is a revolution so profound and so far-reaching that mankind—with very few exceptions, of whom Pascal was one

[12] The *term* remains, of course, and Newton still speaks of the Cosmos and its order (as he speaks of *impetus*), but in an entirely new meaning.

[13] As I have endeavoured to show elsewhere (*Études Galiléennes*, III, *Galilée et la loi d'inertie* [Paris, 1940]) modern science results from this unification of astronomy and physics which enables it to apply the methods of mathematical investigation, till then employed in the study of celestial phenomena, to the study of the phenomena of the sublunar world.

[14] Cf. É. Bréhier, *Histoire de la philosophie*, t. II, fasc. 1 (Paris, 1929), 95: "Descartes dégage la physique de la hantise du Cosmos hellénique, c'est-à-dire de l'image d'un certain état privilégié des choses qui satisfait nos besoins esthétiques. . . . Il n'y a pas d'état privilégié puisque tous les états sont équivalents. Il n'y a donc aucune place en physique pour la recherche des causes finales et la considération du meilleur."

—for centuries did not grasp its bearing and its meaning; which, even now, is often misvalued and misunderstood.

Therefore what the founders of modern science, among them Galileo, had to do, was not to criticize and to combat certain faulty theories, and to correct or to replace them by better ones. They had to do something quite different. They had to destroy one world and to replace it by another. They had to reshape the framework of our intellect itself, to restate and to reform its concepts, to evolve a new approach to Being, a new concept of knowledge, a new concept of science—and even to replace a pretty natural approach, that of common sense, by another which is not natural at all.[15]

This explains why the discovery of things, of laws, which today appear so simple and so easy as to be taught to children—the laws of motion, the law of falling bodies—required such a long, strenuous, and often unsuccessful effort of some of the greatest geniuses of mankind, a Galileo, a Descartes.[16] This fact in turn seems to me to disprove the modern attempt to minimize, or even to deny, the originality, or at least the revolutionary character, of Galileo's thinking; and to make clear that the apparent continuity in the development of medieval and modern physics (a continuity so emphatically stressed by Caverni and Duhem)[17] is an illusion. It

[15] Cf. P. Tannery, "Galilée et les principes de la dynamique," in *Mémoires scientifiques*, VI (Paris, 1926), 399: "Si pour juger le système dynamique d'Aristote, on fait abstraction des préjugés qui dérivent de notre éducation moderne, si on cherche à se replacer dans l'état d'esprit que pouvait avoir un penseur indépendant au commencement du XVIIe siècle, il est difficile de méconnaître que ce système est beaucoup plus conforme que le nôtre à l'observation immédiate des faits."

[16] Cf. my *Études Galiléennes*, II, *La loi de la chute des corps* (Paris, 1940).

[17] Cf. Caverni, *Storia del metodo sperimentale in Italia*, 5 vols. (Firenze, 1891–96), particularly vols. IV and V; P. Duhem, *Le mouvement absolu et le mouvement relatif* (Paris, 1905); "De l'accélération produite par une force constante," *Congrès International de l'histoire des sciences, IIIe session*, (Geneva, 1906); *Études sur Léonard de Vinci: Ceux qu'il a lu et ceux qui l'ont lu*, 3 vols. (Paris, 1909–1913), particularly vol. III, *Les précurseurs parisiens de Galilée*. Quite recently the thesis of continuity has been upheld by J. H. Randall, Jr., in his brilliant article "Scientific Method in the School of Padua," *Journal of the History of Ideas*, I (1940); Randall convincingly shows the progressive elaboration of the method of "resolution and composition" in the teaching of the great logicians of the Renaissance. Yet Randall himself states that there was "one element lacking in Zabarella's formulation of method: he did not insist that the principles of natural science be mathematical" (p. 204), and that Cremonini's *Tractatus de paedia* "sounds like the solemn warning of the great tradition of Aristotelian

is true, of course, that an unbroken tradition leads from the works of the Parisian Nominalists to those of Benedetti, Bruno, Galileo and Descartes. (I myself have added a link to the history of that tradition[18]). Still the conclusion drawn therefrom by Duhem is a delusion: a well-prepared revolution is nevertheless a revolution, and in spite of the fact that Galileo himself in his youth (as well as at times Descartes) shared the views and taught the theories of the medieval critics of Aristotle, modern science, the science born from his efforts and discoveries, *does not* follow the inspiration of the "Parisian forerunners of Galileo"; it places itself at once on a quite different level—on a level which I should like to call the Archimedian one. The true forerunner of modern physics is neither Buridan, nor Nicole Oresme, nor even John Philoponos, but Archimedes.[19]

I

The history of the scientific thought of the Middle Ages and of the Renaissance, now beginning to be somewhat better known,[20] can be divided into two periods. Or better, as the chronological order corresponds only very roughly to that division, the history of scientific thought may be, *grosso modo*, divided into three stages or epochs, which correspond in turn to three different types of thinking: the Aristotelian physics first; then the physics of *impetus*, inaugurated, like everything else, by the Greeks, and elaborated in the current of the Fourteenth century by the Parisian nominalists; and finally modern, mathematical, Archimedian or Galilean physics.

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rational empiricism to the triumphant mathematicians" (*ibid.*). As a matter of fact, it is just this "mathematical emphasis added to the logical methodology of Zabarella" (p. 205) which forms, in my opinion, the content of the scientific revolution of the seventeenth century; and, in the opinion of the time, the dividing line between the followers of Plato and those of Aristotle.

[18] Cf. *Études Galiléennes*, I, *A l'aube de la science classique* (Paris, 1940).

[19] The sixteenth century, at least its latter half, is the period of the reception of the study and of the gradual understanding of Archimedes.

[20] We owe that knowledge chiefly to the works of P. Duhem (to the works cited above, n. 17, must be added: *Les Origines de la statique*, 2 vols. [Paris, 1905], and *Le Système du monde*, 5 vols. [Paris, 1913–17]) and to those of Lynn Thorndike (cf. his monumental *History of Magic and Experimental Science*, 6 vols. [New York, 1923–41]). Cf. equally F. J. Dijksterhuis, *Wal en Worp* (Groningen, 1924).

It is these stages that we find represented in the works of the young Galileo, which thus not only give us information on the history—or the prehistory—of his thought, on the *mobiles* and motives which dominated and inspired it, but present us at the same time, condensed and as it were clarified by the admirable mind of its author, a striking and deeply instructive picture of the whole history of pre-galilean physics. Let us briefly follow this story, beginning with Aristotelian physics.

Aristotelian physics is false, of course; and utterly obsolete. Nevertheless, it is a "physics," that is, a highly though non-mathematically elaborated[21] science. It is not a childish phantasy, nor a brute and verbal restatement of common sense, but a theory, that is, a doctrine which, starting of course with the data of common sense, subjects them to an extremely coherent and systematic treatment.[22]

The facts or data which serve as a basis for this theoretical elaboration are very simple, and in practice we admit them just as did Aristotle. It still seems to all of us "natural" to see a heavy body fall "down." And just like Aristotle or St. Thomas, we should be deeply astonished to see a ponderous body—a stone or a bull—rise freely in the air. This would seem to us pretty "unnatural"; and we would look for an explanation in the action of some hidden mechanism.

In the same way we still find it "natural" that the flame of a match points "up," and that we place our pots and pans "on" the fire. We should be astonished and should seek for an explanation if, for instance, we saw the flame turn about and point "down." Shall we call this conception, or rather this attitude, childish and simple? Perhaps. We can even point out that according to Aristotle himself science begins precisely by looking for an explanation for things that appear natural. Still, when thermodynamics asserts as a principle that "heat" passes from a hot to a cold body, but not from the cold to a hot one, does it not simply translate an intuition of common sense that a "hot" body "naturally" becomes cold, but that a cold one does not "naturally" become hot? And even when we are stating that the center of gravity of a system

[21] The Aristotelian physics is essentially non-mathematical. To present it, as Duhem does, *De l'accélération produite par une force constante*, p. 859, simply as based upon another mathematical formula than ours, is an error.

[22] The systematic character of Aristotelian physics is often not sufficiently appreciated by the modern historian of scientific thought.

tends to take the lowest position and does not rise by itself, are we not simply translating an intuition of common sense, the self-same intuition which Aristotelian physics expresses by its distinction of movement into "natural" and "violent"?[23]

Moreover, Aristotelian physics no more rests content than thermodynamics with merely expressing in its language the "fact" of common sense just mentioned; it transposes it, and the distinction between "natural" and "violent" movements takes its place in a general conception of physical reality, a conception of which the principal features seem to be: (a) the belief in the existence of qualitatively determined "natures," and (b) the belief in the existence of a Cosmos—that is, the belief in the existence of principles of order in virtue of which the entirety of real beings form a hierarchically-ordered whole.

Whole, cosmic order, and harmony: these concepts imply that in the Universe things are (or should be) distributed and disposed in a certain determined order; that their location is not a matter of indifference (neither for them, nor for the Universe); that on the contrary each thing has, according to its nature, a determined "place" in the Universe, which is in some sense its own.[24] A place for everything, and everything in its place: the concept of "natural place" expresses this theoretical demand of Aristotelian physics.

The conception of "natural place" is based on a purely static conception of order. Indeed, if everything were "in order," everything would be in its natural place, and, of course, would remain and stay there forever. Why should it depart from it? On the contrary, it would offer a resistance to any attempt to expel it therefrom. This expulsion could be effected only by exerting some kind of *violence,* and the body would seek to come back, if, and when, owing to such a *violence,* it found itself out of "its" place.

Thus every movement implies some kind of cosmic disorder, a disturbance of the world-equilibrium, being either a direct effect of *violence,* or, on the contrary, the effect of the effort of Being to compensate for the *violence,* to recover its lost and troubled order and balance, to bring things back to their natural places, places where they can rest and remain. It is this returning to order

[23] Cf. E. Mach, *Die Mechanik,* 124 sq.

[24] It is only in "its" place that a being comes to its accomplishment and becomes truly itself. And that is the reason why it tends to reach that place.

which constitutes precisely what we have called "natural" movement.[25]

Upsetting equilibrium, returning to order: it is perfectly clear that order constitutes a firm and durable state which tends to extend itself indefinitely. There is therefore no need to explain the state of rest, at least the state of a body at rest in its natural, proper place; it is its own nature which explains it, which explains, for instance, the earth's being at rest in the center of the world. It is obvious likewise that movement is necessarily a transitory state: natural movement ends naturally when it reaches its goal. And as for violent movement, Aristotle is too optimistic to admit that this abnormal status could endure; moreover, violent movement is disorder creating disorder, and to admit that it could endure indefinitely would mean, in fact, to abandon the very idea of a well-ordered Cosmos. Aristotle therefore holds the reassuring belief that nothing which is *contra naturam possit esse perpetuum.*[26]

Thus, as we have just said, in the Aristotelian physics movement is an essentially transitory state. Taken literally, however, this statement would be incorrect, and even doubly incorrect. As a matter of fact movement, though it is for *each of the moved bodies,* or at least for those of the sublunar world, for the movable things of our experience, a necessarily transitory and ephemeral state, is nevertheless for the whole of the world a necessarily eternal, and therefore an eternally necessary phenomenon[27]—a phenomenon which we cannot explain without discovering its origin and cause in the physical as well as the metaphysical structure of the Cosmos. Such an analysis would show that the ontological structure of material Being prevents it from reaching the state of perfection implied in the notion of absolute rest, and would enable us to see the ultimate physical cause of the temporary, ephemeral and variable movements of sublunar bodies in the continuous, uniform, and perpetual movement of the heavenly spheres.[28] On the other hand, movement strictly speaking is not a *state:* it is a

[25] The conceptions of "natural places" and "natural motions" imply that of a finite Universe.

[26] Aristotle, *Physics,* VIII, 8, 215 b.

[27] Movement can result only from a previous movement. Therefore every actual motion implies an infinite series of preceding ones.

[28] In a finite Universe the only uniform movement which can persist indefinitely is a circular one.

process, a flux, a *becoming,* in and by which things constitute, actualize and accomplish themselves.[29] It is perfectly true that becoming has Being as its end; and that movement has rest as its goal. Yet this immutable rest of a fully actualized being is something utterly different from the heavy and impotent immobility of a being unable to move itself; the first is something positive, is "perfection and *actus*"; the second is only a "privation." Movement, therefore—a *processus,* a becoming, a change—finds itself placed ontologically between the two. It is the being of everything that changes, of which the being is alteration and modification and which *is* only in changing and in modifying itself. The famous Aristotelian definition of movement—*actus entis in potentia in quantum est in potentia*—which Descartes will find perfectly unintelligible—expresses admirably the fact: movement is the being—or the *actus*—of everything which is not God.

To move is thus to change, *aliter et aliter se habere,* to change in itself and in respect to others. This implies on the one hand a term of relation or of comparison, in respect to which the thing moved changes its being or relation; which implies—if we are dealing with local movement[30]—the existence of a fixed point in respect to which the moved moves itself, a fixed unmovable point; which obviously can only be the center of the Universe. On the other hand the fact that every change, every process needs a cause to explain it, implies that every movement needs a mover to produce it, which, as long as the movement endures, keeps it going. Movement indeed does not maintain itself, as rest does. Rest—a state or a privation—does not need the action of any cause to explain its persistence. Movement, change, any process of actualization (or of decay), and even of continuous actualization or decay cannot dispense with such action. If you remove the cause, movement will stop. *Cessante causa cessat effectus.*[31]

If we are dealing with "natural" movement, this cause, this motor is the very nature of the body, its "form," which seeks to

[29] Cf. Kurt Riezler, *Physics and Reality* (New Haven, 1940).

[30] Local movement—locomotion—is only one, though a particularly important, kind of "motion" (κίνησις), motion in the realm of space, in contradistinction to alteration, motion in the realm of quality, and generation and decay, motion in the realm of being.

[31] Aristotle is perfectly right. No process of change or becoming can dispense with a cause. And if motion, in modern physics, persists by itself, it is because it is no longer a process.

bring it back to its place, and thus keeps the movement going. *Vice versa,* movement which is *contra naturam* requires throughout its duration the *continuous* action of an *external* mover conjoint to the moved. Remove the mover, and the movement will stop. Detach it from the moved, and the movement will equally stop. Aristotle, as we know well, does not admit action at a distance;[32] every transmission of movement implies according to him a contact. Therefore there are only two kinds of such transmission: pressure and traction. To move a body you have either to push or to pull it. There is no other means.

Aristotelian physics thus forms an admirable and perfectly coherent theory which, to tell the truth, has only one flaw (besides that of being false): that of being contradicted by everyday practice, by the practice of throwing. But a theoretician deserving the name does not allow himself to be troubled by an objection from common sense. If and when he encounters a "fact" that does not fit into his theory, he denies its existence. And if he cannot deny it, he explains it. And it is in the explanation of this everyday fact, the fact of throwing, a movement continuing in spite of the absence of a "mover," a fact apparently incompatible with his theory, that Aristotle gives us the measure of his genius. This answer consists in the explanation of the apparently motorless movement of the projectile by the reaction of the ambiant medium, the air, or the water.[33] The theory is a stroke of genius. Unfortunately (besides being false), from the point of view of common sense it is utterly impossible. No wonder therefore that the criticism of Aristotelian dynamics turns always to the same *questio disputata: a quo moveantur projecta?*

II

We shall come back in a moment to this *questio,* but we must first turn our attention to another detail of Aristotelian dynamics: the negation of any vacuum and of movement in a vacuum. In this dynamics, indeed, a vacuum does not enable movement to proceed more easily; on the contrary, it renders it utterly impossible; this for very profound reasons.

We have already said that in Aristotelian dynamics, every body is conceived as endowed with a tendency to find itself in its natural

[32] The body *tends* to its natural place, but it is not *attracted* by it.

[33] Cf. Aristotle, *Physics,* IV, 8, 215 a; VIII, 10, 267 a; *De Coelo,* III, 2, 301 b; É. Meyerson, *Identité et réalité,* 84.

place, and to come back to it when, and if, by violence it is moved away from it. This tendency explains its (natural) movement: a movement which brings it to its natural place by the shortest and the speediest way. It follows that every natural movement proceeds in a straight line, and that every body travels to its natural place as fast as possible; that is, as fast as its environment, which resists and opposes its movement, allows it to do. If therefore there were nothing to arrest it, if the surrounding medium did not oppose any resistance to its movement through it (as would be the case in a vacuum) the body would travel to "its" place with an infinite speed.[34] But such a movement would be instantaneous and this—with good reason—seems to Aristotle to be utterly impossible. The conclusion is obvious: no (natural) movement can possibly take place in the void. As for violent movement, that, for example, of throwing, movement in a vacuum would be equivalent to movement without a motor; it is obvious that the vacuum is not a physical medium and cannot receive, transmit and keep up a movement. Moreover, in a vacuum (as in the space of the Euclidian geometry) there are no privileged places or directions. In a vacuum there are not, and there cannot be, "natural" places. Therefore a body put into a vacuum would not know where to go, would not have any reason to move in one direction rather than in any other, and thus would not have any reason to move at all. *Vice versa,* once moved, it would have no more reason to stop here rather than there, and thus it would have no reason to stop at all.[35] Both of which are utterly absurd.

Aristotle is once more perfectly right. An empty space (the space of geometry) is utterly destructive of the conception of a cosmic order: in an empty space there are not only no natural places,[36] there are no *places* at all. The idea of a vacuum is not compatible with the interpretation of movement as change and as process—perhaps not even with that of the concrete movement of concrete "real," perceptible, bodies: I mean the bodies of our common everyday experience. The vacuum is a *non-ens;*[37] and to place things in such a *non-ens* is absurd.[38] Geometrical bodies alone can be "placed" in a geometrical space.

[34] Cf. Aristotle, *Physics,* VII, 5, 249 b, 250 a; *De Coelo,* III, 2, 301 e.

[35] Cf. Aristotle, *Physics,* IV, 8, 214 b; 215 b.

[36] If one likes it better, one can say that in a vacuum all places are the natural places of every kind of body.

[37] Kant called empty space an *"Unding."*

[38] Such was, as we know, the opinion of Descartes; and of Spinoza.

The physicist investigates real things, the geometer reasons about abstractions. Therefore, contends Aristotle, nothing could be more dangerous than to mingle together geometry and physics, and to apply purely geometrical method and reasoning to the study of physical reality.

III

I have already mentioned that Aristotelian dynamics, in spite—or perhaps because—of its theoretical perfection, was burdened with an important draw-back; that of being utterly implausible and completely unbelievable and unacceptable to plain sound common sense, and obviously contradictory to the commonest everyday experience. No wonder therefore that it never enjoyed universal recognition, and that the critics and adversaries of the dynamics of Aristotle always opposed to it the common-sense fact of the persistence of movement separated from its original motor. Thus the classical examples of such movement, for instance the continuing rotation of the wheel, the flight of the arrow, the throwing of a stone, were persistently marshalled against it, beginning with Hipparchus and John Philoponos, through John Buridan and Nicole Oresme, down to Leonardo da Vinci, Benedetti and Galileo.[39]

I do not propose to analyze here the traditional arguments which since John Philoponos[40] have been repeated by the partisans of his dynamics. *Grosso modo* they can be classified into two

[39] For the history of the medieval criticism of Aristotle cf. the works cited above, n. 17, and B. Jansen, "Olivi, der älteste scholastische Vertreter des heutigen Bewegungsbegriffes," *Philosophisches Jahrbuch* (1920); K. Michalsky, "La physique nouvelle et les différents courants philosophiques au XIVe siècle," *Bulletin international de l'Académie polonaise des sciences et des lettres* (Cracovie, 1927); S. Moser, *Grundbegriffe der Naturphilosophie bei Wilhelm von Occam* (Innsbruck, 1932); E. Borchert, *Die Lehre von der Bewegung bei Nicolaus Oresme* (Münster, 1934); R. Marcolongo, "La Meccanica di Leonardo da Vinci," *Atti della reale accademia delle scienze fisiche e matematiche,* XIX (Napoli, 1933).

[40] On John Philoponos, who seems to be the real inventor of the theory of the *impetus,* cf. E. Wohlwill, "Ein Vorgänger Galileis im VI. Jahrhundert," *Physicalische Zeitschrift,* VII (1906), and P. Duhem, *Le Système du Monde,* I. The *Physics* of John Philoponos, not having been translated into Latin, remained inaccessible to the scholastics, who had at their disposal only the brief account given by Simplicius. But it was well known to the Arabs, and the Arabic tradition, directly and through the translation of Avicenna, seems to have influenced the "Parisian" school to a hitherto unsuspected degree. Cf. the very important article of S. Pines, "Études sur Awhad al-Zamān Abu'l Barakat al-Baghdadi," *Revue des Études Juives* (1938).

groups: a) the first arguments are material and stress the improbability of the assumption that a big and heavy body, a bullet, a revolving mill-stone, an arrow flying against the wind, could be moved by the reaction of the air; b) the others are formal and point out the contradiction involved in attributing to the air a double rôle, that of resistance and that of being a mover, as well as the illusory character of the whole theory which only shifts the problem from the body to the air and is, in fact, obliged to endow the air with the same ability to maintain its movement in spite of its separation from its external cause which it denies to other bodies. If so, they ask, why not assume that the mover transmits to the moved, or impresses it with, something which enables it to move—a something which is called δύναμις, *virtus motiva, virtus impressa, impetus, impetus impressus,* sometimes *forza* or even *motio,* and which is always thought of as some kind of power or force, which passes from the mover to the *mobile,* and which then carries on the movement, or better, which produces the movement as its cause.

It is obvious, as Duhem himself recognized, that we are back with common sense. The partisans of the *impetus* physics are thinking in terms of everyday experience. Is it not clear that we need an *effort,* a deployment and an expenditure of force, in order to move a body, for instance in order to push a carriage along its path, to throw a stone or to bend a bow? Is it not clear that it is this force which moves the body, or better, which makes it move?—that it is this force which the body receives from the mover that enables it to overcome resistance (like that of the air) and to strike at obstacles?

The medieval followers of *impetus* dynamics discuss at great length, and without success, the ontological status of *impetus.* They try to fit it into the Aristotelian classification, to interpret it as some kind of *form,* or as a kind of *habitus,* or as a kind of quality such as heat (like Hipparchus and Galileo). These discussions only show the confused, imaginative nature of the conception, which is a direct product or, if one may say so, a condensation, of common sense.

As such it is even more in accord than the Aristotelian view with the "facts"—real or imaginary—which form the experiential basis of medieval dynamics; and particularly with the well known "fact" that every projectile begins by increasing its speed and

acquires the maximum of its velocity some time after its separation from the mover.[41] Everybody knows that in order to jump an obstacle one has to "make a take-off;" that a chariot which one pushes, or pulls, starts slowly and little by little increases its speed; it too takes off and gathers momentum; just as everybody—even a child throwing a ball—knows that in order to hit the goal hard he has to place himself at a certain distance from it, and not too near, in order to allow the ball to gather momentum. The physics of *impetus* is not at pains to explain this phenomenon; from its standpoint it is perfectly natural that *impetus* should require some time before it "takes hold" of the *mobile*—just as, for example, heat needs time to permeate a body.

The conception of movement underlying and supporting *impetus* physics is quite different from that of the Aristotelian view. Movement is no longer understood as a process of actualization.

[41] It is interesting to note that this absurd belief, shared and taught by Aristotle (*De Coelo*, II, 6), was so deeply rooted and so universally accepted that Descartes himself did not dare to deny it outright, and as so often with him preferred to explain it. In 1630 he writes to Mersenne (A. T., I, 110): "Je voudrais bien aussi sçavoir si vous n'avez point expérimenté si une pierre jettée avec une fronde, ou la bale d'un mousquet, ou un traist d'arbaleste, vont plus viste et ont plus de force au milieu de leur mouvement qu'ils n'en ont au commencement, et s'ils font plus d'effet. Car c'est là la créance du vulgaire, avec laquelle toutefois mes raisons ne s'accordent pas; et je trouve que les choses qui sont poussées et qui ne se meuvent pas d'elles mêmes, doivent avoir plus de force au commencement qu'incontinent après." In 1632 (A. T., I, 259) and once more in 1640 (A. T., II, 37 sq.) he explains to his friend what is true in this belief: "*In motu projectorum,* ie ne croie point que le Missile aille jamais moins vite au commencement qu'à la fin, à conter dès le premier moment qu'il cesse d'être poussé par la main ou la machine; mais je crois bien qu'un mousquet, n'estant éloigné que d'un pied et demi d'une muraille n'aura pas tant d'effet que s'il en était éloigné de quinze ou de vingt pas, à cause que la bale, en sortant du mousquet ne peut si aisement chasser l'air qui est entre lui et cette muraille et ainsi doit aller moins viste que si cette muraille estoit moins proche. Toutefois c'est à l'expérience de déterminer si cette différence est sensible et je doute fort de toutes celles que je n'ai pas faites moi-même." Descartes' friend, Beekmann, on the contrary, denies flatly the possibility of an acceleration of the projectile and writes (*Beekmann à Mersenne,* Apr. 30, 1630, cf. *Correspondance du Père Mersenne* [Paris, 1936], II, 437): "Funditores vero ac pueri omnes qui existimant remotiora fortius ferire quam eadem propinquiora, certo certius falluntur." Yet he admits that there must be something true in this belief and tries to explain: "Non dixeram plenitudinem nimiam aeris impedire effectum tormentorii globi, sed pulverem pyrium extra bombardam jam existentem forsitan adhuc rarefieri, ideoque fieri posse ut globus tormentarius extra bombardam nova vi (simili tandem) propulsus velocitate aliquamdiu cresceret."

Yet it is still a change, and as such it must be explained by the action of a definite force or cause. *Impetus* is just that immanent cause which produces the movement, which is *converso modo* the effect produced by it. Thus the *impetus impressus produces* the movement; it *moves* the body. But at the same time it plays another very important rôle: it overcomes the resistance opposed by the medium to the movement.

Owing to the confused and ambiguous character of the *impetus* conception, it is rather natural that the two aspects and rôles should merge together, and that some of the partisans of the *impetus* dynamics should come to the conclusion that, at least in some special cases such as the circular movement of the heavenly spheres, or, more generally, the rolling movement of a circular body on a level plane, or even more generally in all the cases where there is no external resistance to movement, such as would be the case in a *vacuum,* the *impetus* does not weaken but remains "immortal." This seems to be a close approach to the law of inertia, and it is therefore of particular interest and importance to note that Galileo himself, who in his *De Motu* gives us one of the best expositions of *impetus* dynamics, resolutely denies the possibility of such an assumption, and asserts most vigorously the essentially perishable nature of *impetus.*

Galileo is obviously perfectly right. If movement is understood as the effect of *impetus* considered as its immanent—and not natural—cause, it is unthinkable and absurd not to admit that the cause or force which produces it must necessarily spend and finally exhaust itself in this production. It can never remain unchanged for two consecutive moments, and therefore the movement which it produces must necessarily slow down and come to an end.[42] Thus it is a very important lesson that we learn from the young Galileo. He teaches us that *impetus* physics, though compatible with movement in a *vacuum,* is like that of Aristotle *incompatible* with the principle of inertia. And this is not the only lesson that Galileo teaches with regard to *impetus* physics. The second is at least as valuable as the first. It runs that, like that of Aristotle, the dynamics of *impetus* is incompatible with mathematical treatment. It leads nowhere. It is a blind alley.

Impetus physics, during the thousand years that separate John Philoponos from Benedetti, made very little progress. But in the

[42] Cf. Galileo Galilei, *De Motu, Opere,* Ed. Naz., I, 314 sq.

latter's works, and even more clearly, more consistently and consciously, in those of the young Galileo, we find—under the obvious and unmistakable influence of the "suprahuman Archimedes"[43] a determined attempt to apply to this physics the principles of "mathematical philosophy."[44]

Nothing is more instructive than the study of this attempt—or, more exactly, of these attempts—and of their failure. They show us that it is impossible to mathematize, i.e., to transform into an exact, mathematical concept, the rude, vague and confused conception of *impetus*. In order to build up a mathematical physics following the lines of the statics of Archimedes, this conception had to be dropped altogether.[45] A new and original concept of motion had to be formed and developed. It is this new concept that we owe to Galileo.

IV

We are too well acquainted with, or rather too well accustomed to, the principles and concepts of modern mechanics, so well that it is almost impossible for us to see the difficulties which had to be overcome for their establishment. They seem to us so simple, so natural, that we do not notice the paradoxes they imply and contain. Yet the mere fact that the greatest and mightiest minds of mankind—Galileo, Descartes—had to struggle in order to make them theirs, is in itself sufficient to indicate that these clear and simple notions—the notion of movement or that of space—are not so clear and simple as they seem to be. Or they are clear and simple only from a certain point of view, only as part of a certain set of concepts and axioms, apart from which they are not simple at all. Or, perhaps, they are too clear and too simple: so clear and so simple that, like all prime notions, they are very difficult to grasp.

Movement, space—let us try to forget for a while all we have learnt at school; let us try to think out what they mean in mechanics. Let us try to place ourselves in the situation of a contemporary of Galileo, a man accustomed to the concepts of Aris-

[43] Galileo Galilei, *De Motu*, 300.

[44] J. B. Benedetti, *Diversarum speculationum mathematicarum liber* (Taurini, 1585), 168.

[45] The persistence of the terminology—the word *impetus* is used by Galileo and his pupils and even by Newton—must not prevent us from recognizing the disappearance of the idea.

totelian physics which *he* learnt at *his* school, and who encounters for the first time the modern concept of motion. What is it? In fact something pretty strange. It is something which in no way affects the body which is endowed with it: to be in motion or to be at rest does not make any difference for, nor any change in, the body in motion or at rest. The body, as such, is utterly and absolutely indifferent to both.[46] Therefore, we are not able to ascribe motion to a determined body considered in itself. A body is in motion only in relation to some other body which we assume to be at rest. All motion is relative. And therefore we may ascribe it to the one or to the other of the two bodies, *ad libitum*.[47]

Thus motion seems to be a relation. But at the same time it is a *state*, just as rest is another *state*, utterly and absolutely opposed to the former; besides which they are both *persistent states*.[48] The famous first law of motion, the law of inertia, teaches us that a body left to itself persists eternally in its state of motion or of rest, and that we must apply a force in order to change a state of motion to a state of rest, and *vice versa*.[49] Yet not every kind of motion is thus endowed with an eternal being, but only uniform movement in a straight line. Modern physics affirms, as well we know, that a body once set in motion conserves eternally its direction and speed, provided of course it is not subject to the action of any external force.[50] Moreover, to the objection of the Aristotelian that though as a matter of fact he is acquainted with eternal motion, the eternal circular motion of the heavenly spheres, he has never yet encountered a persistent rectilinear one, modern physics replies: of course! rectilinear, uniform motion is utterly impossible, and can take place only in a vacuum.

Let us think it over, and perhaps we will not be too harsh on the Aristotelian who felt himself unable to grasp and to accept this

[46] In the Aristotelian physics, motion is a process of change and always affects the body in motion.

[47] A given body, therefore, can be endowed with any number of different motions, which do not interfere with each other. In the Aristotelian as well as in the *impetus* physics every motion interferes with every other and sometimes even prevents it from taking place.

[48] Motion and rest are thus placed on the same ontological level, and therefore persistence of *motion* becomes just as self-evident and without need of explanation as persistence of *rest* had previously been.

[49] In modern terms: in the Aristotelian and *impetus* dynamics, force produces motion; in modern dynamics, force produces acceleration.

[50] This implies necessarily the infinity of the Universe.

unheard-of notion, the notion of a persistent, substantial relation-state, the concept of something which to him seemed just as abstruse, and just as impossible, as the ill-fated substantial forms of the scholastics appear to us. No wonder that the Aristotelian felt himself astonished and bewildered by this amazing attempt to explain the real by the impossible—or, which is the same thing, to explain real being by mathematical being, because, as I have mentioned already, these bodies moving in straight lines in infinite empty space are not *real* bodies moving in *real* space, but *mathematical* bodies moving in *mathematical* space.

Once more, we are so accustomed to mathematical science, to mathematical physics, that we no longer feel the strangeness of a mathematical approach to Being, the paradoxical daring of Galileo's utterance that the book of Nature is written in geometrical characters.[51] For us it is a foregone conclusion. But not for the contemporaries of Galileo. Therefore it is the right of mathematical science, of the mathematical explanation of Nature, in opposition to the non-mathematical one of common sense and of Aristotelian physics, much more than the opposition between two astronomical systems, that forms the real subject of the *Dialogue on the Two Greatest Systems of the World.* As a matter of fact the *Dialogue,* as I believe I have shown in my ill-fated volume, is not so much a book on *science* in our meaning of the term as a book on philosophy—or to be quite correct and to employ a disused but time-honored expression, a book on *natural philosophy*—for the simple reason that the solution of the astronomical problem depends on the constitution of a new Physics; which in turn implies the solution of the *philosophical* question of the rôle played by mathematics in the constitution of the science of Nature.

The rôle and the place of mathematics in science is not in fact a very new problem. Quite the contrary: for more than two thousand years it has formed the object of philosophical meditation, inquiry and discussion. And Galileo is perfectly aware of it. No wonder! Even as a young boy, a student in the University of Pisa,

[51] G. Galilei, *Il Saggiatore* (*Opere,* VI, 232): "La filosofia è scritta in questo grandissimo libro, che continuamente ci sta aperto innanzi a gli occhi (io dico l'universo), ma non si può intendere se prima non s'impara a intender la lingua, e conoscer i caratteri, ne' quali è scritto. Egli è scritto in lingua matematica, e i caratteri son triangoli, cerchi, ed altre figure geometriche, senza i quali mezi è impossibile a intenderne umanamente parola." Cf. *Letter to Liceti* of Jan. 11, 1641 (*Opere,* XVIII, 293).

he could have learned from the lectures of his master, Francesco Buonamici, that the "question" about the rôle and the nature of mathematics constitutes the principal subject of opposition between Aristotle and Plato.[52] And some years later when he came back to Pisa, this time a professor himself, he could have learned from his friend and colleague, Jacopo Mazzoni, author of a book on Plato and Aristotle, that "there is no other question which has given place to more noble and beautiful speculations . . . than the question whether the use of mathematics in physical science as an instrument of proof and a middle term of demonstration, is opportune or not; in other words, whether it brings us some profit, or on the contrary is dangerous and harmful." "It is well known," says Mazzoni, "that Plato believed that mathematics was quite particularly appropriate for physical investigations, which was the reason

[52] The enormous compilation of Buonamici (1011 pages *in folio*) is an invaluable source-book for the study of medieval theories of motion. Though frequently *mentioned* by historians of Galileo it has never been utilized by them. Buonamici's book is very rare. I allow myself therefore to quote it at some length: Francisci Bonamici, Florentini, e primo loco philosophiam ordinariam in Almo Gymnasio Pisano profitentis, *De Motu, libri X, quibus generalia naturalis philosophiae principia summo studio collecta continentur* (Florentiae, 1591), lib. X, cap. XI. *Jurene mathematicae ex ordine scientiarum expurgantur*, p. 56: . . . "Itaque veluti ministri sunt mathematicae, nec honore dignae et habitae προπαιδεία, id est apparatus quidam ad alias disciplinas. Ob eamque potissime caussam, quod de bono mentionem facere non videntur. Etenim omne bonum est finis, is vero cuiusdam actus est. Omnis vero actus est cum motu. Mathematicae autem motum non respiciunt. Haec nostri addunt. Omnem scientiam ex propriis effici: propria vero sunt necessaria quae alicui [†] quatenus ipsum et per se insunt. Atqui talia principia mathematicae non habent. . . . Nullum caussae genus accipit . . . proptereaquod omnes caussae definiuntur per motum: efficiens enim est principium motus, finis cuius gratia motus est, forma et materia sunt naturae; et motus igitur principia sint necesse est. At vero mathematica sunt immobilia. Et nullum igitur ibi caussae genus existit." *Ibid.*, lib. I, p. 54 "Mathematicae cum ex notis nobis et natura simul efficiant id quod cupiunt, sed caeteris demonstrationis perspicuitate praeponentur, nam vis rerum quas ipsae tractant non est admodum nobilis; quippe quod sunt accidentia, id est habeant rationem substantiae quatenus subiicitur et determinatur quanto; eaque considerentur longe secus atque in natura existant. Attamen nonnullarum rerum ingenium tale esse comperimus ut ad certam materiam sese non applicent, neque motum consequantur, quia tamen in natura quicquid est, cum motu existit; opus est abstractione cuius beneficio quantum motu non comprehenso in eo munere contemplamur; et cum talis sit earum natura nihil absurdi exoritur. Quod item confirmatur, quod mens in omni habitu verum dicit; atqui verum est ex eo, quod res ita est. Huc accedit quod Aristoteles distinguit scientias non ex ratione notionum sed entium."

why he himself had many times recourse to it for the explanation of physical mysteries. But Aristotle held a quite different view and he explained the errors of Plato by his too great attachment to mathematics.''[53]

One sees that for the scientific and philosophical consciousness of the time—Buonamici and Mazzoni are only giving expression to the *communis opinio*—the opposition, or rather the dividing line, between the Aristotelian and the Platonist is perfectly clear. If you claim for mathematics a superior status, if more than that you attribute to it a real value and a commanding position in Physics, you are a Platonist. If on the contrary you see in mathematics an abstract science, which is therefore of a lesser value than those—physics and metaphysics—which deal with real being; if in particular you pretend that physics needs no other basis than experience and must be built directly on perception, that mathematics has to content itself with the secondary and subsidiary rôle of a mere auxiliary, you are an Aristotelian.

What is in question in this discussion is not certainty—no Aristotelian has ever doubted the certainty of geometrical propositions or demonstrations—but Being; not even the use of mathematics in physical science—no Aristotelian has ever denied our right to measure what is measurable and to count what is numerable—but the structure of science, and therefore the structure of Being.

[53] Jacobi Mazzoni, Caesenatis, in Almo Gymnasio Pisano Aristotelem ordinarie Platonem vero extra ordinem profitentis, *In Universam Platonis et Aristotelis Philosophiam Praeludia, sive de comparatione Platonis et Aristotelis* (Venetiis, 1597), 187 sq.: *Disputatur utrum usus mathematicarum in Physica utilitatem vel detrimentum afferat, et in hoc Platonis et Aristotelis comparatio.* Non est enim inter Platonem et Aristotelem quaestio, seu differentia, quae tot pulchris, et nobilissimis speculationibus scateat, ut cum ista, ne in minima quidem parte comparari possit. Est autem differentia, utrum usus mathematicarum in scientia Physica tanquam ratio probandi et medius terminus demonstrationum sit opportunus, vel inopportunus, id est, an utilitatem aliquam afferat, vel potius detrimentum et damnum. Credidit Plato Mathematicas ad speculationes physicas apprime esse accommodatas. Quapropter passim eas adhibet in reserandis mysteriis physicis. At Aristoteles omnino secus sentire videtur, erroresque Platonis adscribet amori Mathematicarum. . . . Sed si quis voluerit hanc rem diligentius considerare, forsan, et Platonis defensionem inveniet, videbit Aristotelem in nonnullos errorum scopulos impegisse, quod quibusdam in locis Mathematicas demonstrationes proprio consilio valde consentaneas, aut non intellexerit, aut certe non adhibuerit. Utramque conclusionem, quarum prima ad Platonis tutelam attinet, secunda errores Aristotelis ob Mathematicas male rejectas profitetur, brevissime demonstrabo."

These are the discussions to which Galileo alludes continuously in the course of his *Dialogue*. Thus at the very beginning Simplicio, the Aristotelian, points out that "concerning natural things we need not always seek the necessity of mathematical demonstrations."[54] To which Sagredo, who allows himself the pleasure of misunderstanding Simplicio, replies: "Of course, when you cannot reach it. But, if you can, why not?" Of course. If it is possible in questions pertaining to natural things to achieve a demonstration possessing a mathematical necessity, why shouldn't we try to do it? But is it possible? That is precisely the problem, and Galileo, in the margin of the book, sums up the discussion and formulates the real meaning of the Aristotelian: "In natural demonstrations," says he, "one must not seek mathematical exactitude."

One must not. Why? Because it is impossible. Because the nature of physical being is qualitative and vague. It does not conform to the rigidity and the precision of mathematical concepts. It is always "more or less." Therefore, as the Aristotelian will explain to us later, philosophy, that is the science of the real, does not need to look at details, nor need it have recourse to numerical determinations in formulating its theories of motion; all that it has to do is to develop its chief categories (natural, violent, rectilinear, circular) and to describe its general qualitative and abstract features.[55]

The modern reader is probably far from being convinced. He finds it difficult to admit that "philosophy" had to content itself with abstract and vague generalization and not try to establish precise and concrete universal laws. The modern reader does not know the real reason of this necessity, but Galileo's contemporaries knew it quite well. They knew that quality, as well as form, being non-mathematical by nature, cannot be treated in terms of mathematics. Physics is not applied geometry. Terrestrial matter can never exhibit exact mathematical figures; the "forms" never "inform" it completely and perfectly. There always remains a gap. In the skies, of course, it is different; and therefore mathematical astronomy is possible. But astronomy is not physics. To have missed that point is precisely the error of Plato and of those who follow Plato. It is useless to attempt to build up a mathematical

[54] Cf. Galileo Galilei, *Dialogo sopra i due Massimi Sistemi del Mondo, Opere*, Ed. Naz., VII, 38; cf. 256.

[55] Cf. *Dialogo*, 242.

philosophy of nature. The enterprise is doomed even before it starts. It does not lead us to truth but to error.

"All these mathematical subtleties," explains Simplicio, "are true in *abstracto*. But applied to sensible and physical matter, they do not work."[56] In real nature there are no circles, no triangles, no straight lines. Therefore it is useless to learn the language of mathematical figures: the book of Nature, in spite of Galileo and Plato, is not written in them. In fact, it is not only useless, it is dangerous: the more a mind is accustomed to the precision and to the rigidity of geometrical thought, the less it will be able to grasp the mobile, changing, qualitatively determined variety of Being.

This attitude of the Aristotelian is very far from being ridiculous.[57] To me, at least, it seems perfectly sensible. You cannot establish a mathematical theory of quality, objects Aristotle to Plato; not even one of motion. There is no motion in numbers. But *ignorato motu ignoratur natura*. And the Aristotelian of Galileo's time could add that the greatest of the Platonists, the *divus* Archimedes himself,[58] was never able to establish more than a statics. Not a dynamics. A theory of rest. Not one of motion.

The Aristotelian was perfectly right. It is impossible to furnish a mathematical deduction of quality. And well we know that Galileo, like Descartes somewhat later, and for just the same reason, was forced to drop the notion of quality, to declare it subjective, to ban it from the realm of nature.[59] This at the same time implies that he was obliged to drop sense-perception as the source of knowledge and to proclaim that intellectual, and even *a priori* knowledge, is our sole and only means of apprehending the essence of the real.

As for dynamics, and the laws of motion—the *posse* is only to be proved by the *esse;* in order to show that it is possible to establish mathematical laws of nature, you have to do it. There is no other way and Galileo is perfectly conscious of it. It is therefore by giving mathematical solutions to concrete physical problems—the problem of falling bodies, the problem of projectile motion—

[56] *Ibid.*, 229, 423.

[57] As we know, it was shared by Pascal, and even by Leibniz.

[58] It is perhaps worth mentioning that for all the doxographic tradition, Archimedes is a *philosophus platonicus*.

[59] Cf. E. A. Burtt, *The Metaphysical Foundations of Modern Physical Science* (London and New York, 1925).

that he leads Simplicio to the confession "that to want to study natural problems without mathematics is to attempt something that cannot be done."

It seems to me that we are now able to understand the meaning of this significant text of Cavalieri, who in 1630 writes in his *Specchio Ustorio:* "How much is added by the knowledge of the mathematical sciences, which the famous schools of Pythagoreans and Platonists considered supremely necessary for the comprehension of physical things, I hope will shortly become clear with the publication of the new science of movement promised by this marvellous Assayer of Nature, Galileo Galilei."[60]

And we understand too the pride of Galileo the Platonist, who in his *Discourses and Demonstrations* announces that "about a most ancient subject he will promote a quite new science," and will prove something that nobody has proven till then, namely that the movement of falling bodies is subjected to the law of numbers.[61] Movement governed by numbers; the Aristotelian objection had at last met its refutation.

It is obvious that for the disciples of Galileo just as for his contemporaries and elders mathematicism means Platonism. Therefore when Torricelli tells us "that among the liberal disciplines geometry *alone* exercises and sharpens the mind and renders it able to be an ornament of the City in time of peace and to defend it in time of war," and that "*caeteris paribus,* a mind trained in geometrical gymnastics is endowed with a quite particular and *virile* strength,"[62] not only does he show himself an authentic

[60] Bonaventura Cavalieri, *Lo Specchio Ustorio overo trattato Delle Settioni Coniche e alcuni loro mirabili effetti intorno al Lume* etc. (Bologna, 1632), 152 sq.: "Ma quanto vi aggiunga la cognitione delle scienze Matematiche, giudicate da quelle famosissime scuole de' Pithogorici et de' 'Platonici,' sommamente necessarie per intender le cose Fisiche, spero in breve sarà manifesto, per la nuova dottrina del moto promessaci dall'esquisitissimo Saggiatore della Natura, dico dal Sig. Galileo Galilei, ne' suoi Dialoghi. . . ."

[61] Galileo Galileo, *Discorsi e dimostrazioni mathematiche intorno a due nuove scienze* (*Opere,* Ed. Naz., VIII, 190): "nullus enim, quod sciam, demonstravit, spatia a mobile descendente ex quiete peracta in temporibus aequalibus, eam inter se retinere rationem, quam habent numeri impares ab unitate consequentes."

[62] Evangelista Torricelli, *Opera Geometrica* (Florentiae, 1644), II, 7: "Sola enim Geometria inter liberales disciplinas acriter exacuit ingenium, idoneumque reddit ad civitates adornandas in pace et in bello defendendas: caeteris enim paribus, ingenium quod exercitatum sit in Geometrica palestra, peculiare quoddam et virile robur habere solet: praestabitque semper et antecellet, circa studia Architecturae, rei bellicae, nauticaeque, etc."

disciple of Plato, he acknowledges and proclaims himself to be one. And in doing it he remains a faithful disciple of his master Galileo, who in his *Response to the Philosophical Exercitations* of Antonio Rocco addresses himself to the latter, asking him to judge for himself the value of the two rival methods, i.e., the purely physical and empirical method and the mathematical one, adding: "and decide at the same time who reasoned better, Plato, who said that without mathematics one could not learn philosophy, or Aristotle, who reproached this same Plato for having too much studied Geometry."[63]

I have just called Galileo a Platonist. And I believe that nobody will doubt that he is one.[64] Moreover, he says so himself. In the very first pages of the *Dialogue* Simplicio makes the remark that Galileo, being a mathematician, is probably sympathetic to the numerical speculations of the Pythagoreans. This enables Galileo to declare that he deems them perfectly meaningless, and to say at the same time: "I know perfectly well that the Pythagoreans had the highest esteem for the science of number and that Plato himself admired the human intellect and believed that it participates in divinity solely because it is able to understand the nature of numbers. And I myself am well inclined to make the same judgment."[65]

[63] Galileo Galilei, *Esercitazioni filosofiche di Antonio Rocco, Opere,* Ed. Naz., VII, 744.

[64] The Platonism of Galileo Galilei has been more or less clearly recognized by certain modern historians of science and philosophy. Thus the author of the German translation of the *Dialogo* notes the Platonic influence (the doctrine of anamnesis) on the very form of the book (cf. G. Galilei, *Dialog über die beiden hauptsächlichsten Weltsysteme,* aus dem italienischen übersetzt und erläutert von E. Strauss [Leipzig, 1891], p. XLIX); E. Cassirer (*Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit,* 2 ed. [Berlin, 1911], I, 389 sq.) insists upon the Platonism of Galileo's ideal of knowledge; L. Olschki (*Galileo und seine Zeit,* Leipzig, 1927) speaks about the "Platonic vision of Nature" of Galileo, etc. It is E. A. Burtt, *The Metaphysical Foundations of Modern Physical Science* (New York, 1925), who seems to me to have given the best account of the metaphysical substructure (Platonic mathematicism) of modern science. Unfortunately Burtt failed to recognize the existence of *two* (and not one) Platonic traditions, that of mystical arithmology, and that of mathematical science. The same error, which in the case of Burtt was a venial sin, was made by his critic, E. W. Strong, *Procedures and Metaphysics* (Berkeley, Cal., 1936), and in this case it was a mortal one.—On the distinction between the two Platonisms cf. L. Brunschvieg, *Les Étapes de la philosophie mathématique* (Paris, 1922), 69 sq., and *Le Progrès de la conscience dans la philosophie occidentale* (Paris, 1937), 37 sq.

[65] *Dialogo,* 35.

How could he be of a different opinion, he who believed that in mathematical knowledge the human mind attains the very perfection of the divine understanding? Does he not say that "*extensive*, that is in respect of the multiplicity of things to be known, which is infinite, the human mind is as nothing (even if it understood a thousand propositions, because a thousand compared with infinity is like zero): but taking the understanding *intensive*, in so far as this term means to grasp intensely, that is, perfectly a given proposition, I say that the human mind understands some propositions as perfectly and has of them as absolute certainty as Nature herself can have; and of that kind are the pure mathematical sciences, that is, geometry and arithmetic, of which the divine intellect knows of course infinitely more propositions, for the simple reason that it knows them all; but as for those few understood by the human intellect, I believe that our knowledge equals the divine in objective certainty, because it succeeds in understanding their necessity, beyond which it does not seem that there can exist a greater certainty."[66]

Galileo could have added that the human understanding is so excellent a work of God that *ab initio* it is in possession of these clear and simple ideas of which the very simplicity is a guarantee of truth, and that it has only to turn to itself in order to find in its "memory" the true foundations of science and knowledge, the alphabet, i.e., the elements, of the language—the mathematical language—spoken by the Nature God has created. There is to be found the true foundation of a *real* science, a science of the *real* world—not of a science endowed with a purely formal truth, the intrinsic truth of mathematical reasoning and deduction, a truth which would not be affected by the non-existence in Nature of the objects studied by it: it is obvious that Galileo would no more than Descartes ever rest content with such an *Ersatz* for real science and knowledge.

It is of this science, the true "philosophic" knowledge which is knowledge of the very essence of Being, that Galileo proclaims: "And I, I say to you that if one does not know the truth by himself, it is impossible for anyone else to give him that knowledge. It is indeed possible to teach those things that are neither true nor false; but the true, by which I mean necessary things, that is, those for which it is impossible to be otherwise, every average mind

[66] *Dialogo*, 128 sq.

either knows by itself, or it is impossible for it ever to learn them."[67] Assuredly. A Platonist cannot be of a different opinion because for him to know is nothing else than to understand.

The allusions to Plato so numerous in the works of Galileo, and the repeated mention of the Socratic maieutics and of the doctrine of reminiscence, are not superficial ornaments born from his desire to conform to the literary mode inherited from the concern of Renaissance thought with Plato. Nor are they meant to gain for the new science the sympathy of the "common reader," tired and disgusted by the aridity of Aristotelian scholastics; nor to cloak himself against Aristotle in the authority of his master and rival, Plato. Quite the contrary: they are perfectly serious, and must be taken at their face value. Thus, that no one might have the slightest doubt concerning his philosophical standpoint, Galileo insists:[68] "SALVIATI: The solution of the question under discussion implies the knowledge of certain truths that are just as well known to you as to me. But, as you do not remember them, you do not see that solution. In this way, without teaching you, because you know them already, but only by recalling them to you, I shall make you solve the problem yourself."

"SIMPLICIO: Several times I have been struck by your manner of reasoning, which makes me think that you incline to the opinion of Plato that *nostrum scire sit quoddam reminisci;* pray, free me from this doubt and tell me your own view."

"SALV: What I think of this opinion of Plato I can explain by words, and also by facts. In the arguments so far advanced I have already more than once declared myself by fact. Now I will apply the same method in the inquiry we have in hand, an inquiry which may serve as an example to help you more easily to understand my ideas concerning the acquisition of science. . . ."

The inquiry "we have in hand" is nothing else than the deduction of the fundamental propositions of mechanics. We are informed that Galileo judges he has done more than merely declare himself a follower and a partisan of Platonic epistemology. In addition, by applying it, by discovering the true laws of physics, by letting them be deduced by Sagredo and Simplicio, that is, *by the reader* himself, by *us,* he believes he has demonstrated the truth of Platonism "by fact." The *Dialogue* and the *Discourses* give

[67] *Dialogo,* 183.

[68] *Dialogo,* 217.

us the history of an intellectual experiment—of a conclusive experiment, because it ends with the wistful confession of the Aristotelian Simplicio, acknowledging the necessity of the study of mathematics, and regretting that he himself had not learned them in his youth.

The *Dialogue* and the *Discourses* tell us the history of the discovery, or better still, of the rediscovery of the language spoken by Nature. They explain to us the manner of questioning her, i.e., the theory of that scientific experimentation in which the formulation of postulates and the deduction of their implications precedes and guides the recourse to observation. This too, at least for Galileo, is a proof "by fact." The new science is for him an experimental proof of Platonism.

École Libre des Hautes Études.

ATTITUDES OF SOME MODERN RATIONALISTS TO HISTORY

By Jerome Rosenthal

I

It is generally believed that anti-historicism constitutes one of the most characteristic trends in the philosophy of the seventeenth- and eighteenth-century rationalists, and that this trend received its deathblow at the hands of Hegel, the last great rationalistic philosopher of history. This characterization is obviously determined by the modern conception of history as a descriptive and genetic account of cultural or social life. Thus conceived, history is like all significant studies an empirical discipline. And an empirical approach to man's history presents no methodological problems incapable of objective analysis. In fact it is legitimate to say that all significant knowledge and all empirical sciences are historical. This is true not only in the sense that eternal truths have no place in science, that scientific conclusions are relative to the data available at given periods, but above all in the sense that all evidence in empirical science is based on inferences and past experience and not on clairvoyance or direct, immediate, intuitive insights. The inferential nature of empirical evidence clearly implies that probabilities and conjectures, far from being peculiar to history and far from constituting a vice, are essential to all significant and fruitful knowledge.

To be sure, certain superconscientious historians, afraid of contaminating their discipline with speculations and believing that it is the nature of an empirically oriented discipline to operate with self-luminous facts and to deliver irrefutable truths, have been insisting that history must be confined to statements about individual occurrences. Now the isolationism of these historians may have its roots in the teachings of traditional "sensationalistic empiricism." But whatever may be the case with this traditional empiricism, it is quite compatible with an enlightened and critical empiricism to point out that history, like the natural sciences, is not to be identified with descriptive statements about individual and naked facts; in its perusal of subject-matter it is guided by theories, whether they be understood as interpretative assumptions

or explanatory hypotheses or principles of selection. No violence is thus done to the spirit of a well-understood empiricism, so long as the assumptions are warranted by the material at hand, so long as the hypotheses are regarded as subject to revision, and so long as the principles of selection are taken as heuristic and regulative rather than as constitutive and artificially introduced from an irrelevant domain.

The peculiar attitude of the modern rationalists towards history can be understood primarily in the light of their conception of empiricism. For most of the modern rationalists history is the very incarnation of all the evils they impute to empiricism. This is particularly true of Descartes and Malebranche, and largely also of Leibniz. For Descartes and Malebranche history is devoid both of all cognitive worth and of any useful function. If dependence upon sensation and memory was a virtue for Hobbes[1] and led him to regard history as yielding absolute knowledge, this circumstance constituted a vice for the Cartesians. Complete reliance upon sensation, memory, and hence upon experience, implied for Descartes that the knowledge upon which history is based is merely of a probable, conjectural, contingent and therefore of a dubious nature. It is Descartes' conviction that "all science consists of certain and evident knowledge" and that probable knowledge is incompatible with it.[2] The knowledge gained through the study of history leads us nowhere, not only because it is conjectural but also because it is acquired in a mechanical fashion through memory without requiring our reasoning powers. "The study of history, languages, geography, and of everything that depends exclusively upon experience gives us simple knowledge acquired without the aid of reasoning."[3] Descartes goes so far as to declare that "the knowledge of Greek and Latin can be no more incumbent upon an educated person than that of Swiss or Breton, and the study of the history of the Romano-Germanic empire is no more necessary than that of the smallest state of Europe."[4]

Malebranche does not lag behind his teacher in this respect. "History, grammar, the laws and customs of particular countries,

[1] Hobbes, *Leviathan* (Everyman ed.), 41.

[2] Descartes, *Règles pour la direction de l'esprit,* in *Oeuvres choisies* (Paris, Garnier Frères), 301.

[3] Descartes, *Recherche de la vérité par la lumière naturelle, op. cit.,* 389.

[4] *Ibid.*

and those disciplines which depend on the fluctuations of the human will contain nothing but contingent truths.''[5] And as to the usefulness of history, Malebranche does not hesitate to assert that a single principle of physics contains more truth than can be found in all the books of history.[6] The primary if not the only function of history is to satisfy curiosity.[7] But unlike the curiosity which leads to scientific research, the stimulus connected with the study of history is, in his opinion, aimed not at arousing reflection, or at dispelling ignorance, or at removing the veil of mystery from things, but at keeping the powers of reasoning in suspense through feeding the imagination with stories of marvels, extraordinary events, and bizarre facts. Malebranche speaks sarcastically about those persons who display no interest in what is going on around them and yet hunt continually for ''histories of the rarest and most ancient occurrences, for surprising and exotic experiences which can never enlighten the mind.''[8]

The anti-historicism of Descartes and Malebranche expresses itself also in the fact that they failed to realize another essential aspect of history, namely, its social and cumulative character. What above all characterizes the cumulative conception is the idea that even the most abstract realms of culture have careers in time, and that consequently the history of the development of these realms is essential to a full understanding of their present nature. For the cumulative conception teaches us to regard our cultural institutions and achievements not as born full-fledged but as products of prolonged and tentative efforts having their roots in a determinate albeit varying social background.

It is because Descartes and Malebranche failed to realize the cumulative nature of culture that their approach to disciplines like philosophy, religion, ethics, and science can be characterized as unhistorical. While insisting that all the sciences are so intimately interconnected that ''it is much easier to master all of them at once than to learn a single one separately,''[9] a typical rationalist

[5] Malebranche, *Recherche de la Vérité* (Paris, Flammarion ed.), Livre I, 25.

[6] *Éloge par Fontenelle,* quoted from Bouillier, *Histoire de la Philosophie Cartésienne,* II, 23.

[7] In order to make us concentrate all our reverence on God, Malebranche praises Descartes for having enabled us to "cease admiring the powers of magnetism, the phenomena of the tides, the generation of meteors, etc." *Recherche de la Vérité,* II, 353.

[8] *Ibid.,* II, 58.

[9] Descartes, *Règles pour la direction de l'esprit, Oeuvres,* ed. Garnier, 300.

like Descartes at the same time declares that a knowledge of the history of the sciences or of philosophy is utterly irrelevant to an understanding of them. He had little respect for those scholars who devote themselves to the study of Plato and Aristotle and who in this way learn history but not science.[10] A combination of science with history can, in his view, lead only to a contamination of the truths and certainties of the former with the conjectures and probabilities of the latter.[11] The most extreme form of the belief that the history of a discipline like philosophy is an utterly useless study is strikingly exhibited by Malebranche. "It is pretty useless for those who live now to know whether there ever lived a man called Aristotle; whether this man actually wrote the books to which his name is attached; whether certain passages in his work should be understood this or that way."[12] Malebranche, moreover, does not confine himself to exposing the futility of an historical approach to Aristotle. He ridicules in general those persons who "spend their time reading books in order to enter into the mentality of their authors, or in order to ascertain what these authors actually meant by certain of their opinions."[13] "Such persons," he continues, "learn to know histories and facts but not evident truths; the science apprehended by them is a science of memory but not of the intellect."[14]

The generating principle of all culture is for most modern rationalists "reason," a faculty infallible in its operations, admitting, as Descartes says, of no degrees, manifesting itself wholly in every individual. There are no two or several universal reasons. Truth is necessary, immutably eternal. "Reason is the same in time as well as in eternity, the same in heaven as in hell. . . . The language of reason is neither French nor German; it is intelligible to all nations, to those who read as well as to those who do not read."[15] In this conception the work of reason is made to

[10] *Ibid.*, 305.

[11] *Ibid.*

[12] Malebranche, *Recherche de la Vérité*, ed. Flammarion, I, 246.

[13] *Ibid.*, 241.

[14] *Ibid.*

[15] Malebranche, *Entretiens métaphysiques* (Paris, 1922), I, 58. Cf. Voltaire (letter to Tronchin, April 18, 1756):

La vérité doit sa lumière
A tous les temps, à tous les lieux.
Reçevons sa clarté chérie
Et, sans songer quel est la main

center exclusively in particular individuals, assumed to be in need neither of the aid of the social legacy left by the past nor of the corrective influence exercised by contemporaries. The only thing such individuals would need for completing the work of reason would be longevity.[16] The belief that the work of reason is non-cumulative is very clearly stated in the following words of Lessing: "Education gives to man nothing that he could not evolve by himself; it only enables him to arrive at ideas in a quicker and easier manner."[17] But perhaps the most striking expression of this view is found in Descartes. He goes so far as to assert that an intellectual construction or system evolved spontaneously by a single individual is more perfect, more harmonious, and hence more rational than a work resulting from the gradual and tentative efforts of numerous men. The prosperity of Sparta, he argues, was due to the fact that its constitution was "the invention of a single individual."[18]

Characteristic in this respect is the attitude of Descartes towards the problem of error. Error was regarded by him as a conscious expression of a desire to mislead. Far from ascribing to errors a heuristic value, far from regarding them as expressions of the provisional and tentative nature of so many scientific theories and, in short, as an integral part of the self-corrective technique so characteristic of all significant knowledge, Descartes looks upon them as manifestations of a bad will obstructing the natural growth of reason. Thus he admonishes us to rescue and preserve reason "as it is given to the individual by nature from the corrupting influence exerted on it by false opinions,"[19] reminding us of the pristine purity of "the first germs of truth that were depos-

Qui la présente au genre humain
Que l'univers soit sa patrie.

[16] Kant sometimes expresses himself in a similar vein: "Under certain conditions a single individual, with a special aptitude for art and science, would be able to carry these disciplines much farther than would be possible for all the generations of scholars working in succession. This would be the case if our hypothetical individual were to attain maturity of judgment through prolonged practice and acquired knowledge, and if he were to retain the same youthful mental vigor throughout the period of time allotted to successive generations." (Kant, *Mutmasslicher Anfang der Menschengeschichte,* Kirchmann ed., 81.)

[17] Lessing, *Erziehung des Menschengeschlechts,* art. 4.

[18] Descartes, *Discours de la Méthode, Oeuvres,* ed. Garnier, 9.

[19] *Recherche de la vérité par la lumière naturelle,* 387.

ited by nature in the human mind and which we stifle through reading and listening everyday to so many errors."[20] And just as he was convinced that a mature individual can attain truth by "resolving to remove from his imagination all imperfect ideas,"[21] so did he believe that many authors deliberately hide their true and simple ideas behind a smoke screen of erroneous and complicated views in order to surround their doings with an air of mystery and in this way to over-awe the public. Thus the fact that the ancient philosophers required from their students a knowledge of mathematics makes him suspect that the ancients possessed a type of mathematics which was both easy and fruitful and hence different from the sterile discipline in vogue in his day.[22] He also utters the suspicion that this true type of mathematics was known to Pappus and Diophantus, who however concealed it through a trick customary among artisans who refuse to divulge the secrets of their inventions in order to retain the admiration of the public.[23]

It is in accordance with these views that so many of the modern rationalists regarded the works of reason as born perfect and full-fledged. The date and place of birth did not matter much. Reason may have delivered itself of masterpieces in ancient Athens or Rome as well as in modern Oxford or Paris. Descartes and many of his followers had little use for art, probably because they found it difficult to apply a demonstrative technique to a qualitative subject-matter. They thus looked for models of perfection in the fields of mathematics, metaphysics, and theology. To question the truth and finality of Euclid was looked upon by certain Cartesians as almost a sacrilege: "Should a geometrician attempt to offer new propositions contrary to those of Euclid, should he claim, after the fashion of Hobbes, to have proven that this geometry is full of errors, I admit that it would be wrong to indulge in such innovations."[24] We also hear Leibniz speak about "models in the art of demonstration bequeathed by Greek mathematics to humanity," although he was quite aware of the formal defects of Euclid.[25] In general mathematics was for most of the modern rationalists a

[20] *Règles pour la direction de l'esprit,* 312.
[21] *Recherche,* 395.
[22] *Règles,* 311–312.
[23] *Ibid.,* 312.
[24] Malebranche, *Recherche de la vérité,* II, 25.
[25] Leibniz, *Nouveaux Essais,* ed. Flammarion, 319.

repository of truths which are inalterable, completely independent of contexts, and given once and for ever. This is attested to in a most striking manner by Descartes. "There is only one truth concerning every object, and whoever finds this truth knows about the given object as much as one can know. Thus, if a child is trained in arithmetic, and if he performs an addition in accordance with the rules of this science, he can be sure to have found with reference to the sum under consideration everything that the human mind could discover."[26]

As to metaphysics, Descartes' attitude towards his own work is quite in harmony with what we have just pointed out. Referring to the metaphysical proofs and reasons he gave in his *Meditations,* he asserts that these reasons are of such a nature that he does not think that "there is any road by which the human intellect could ever discover better ones."[27] Even with regard to physics he was convinced that the job performed by him in this field was so complete and final that there scarcely remained any unsolved problems. At the end of his *Principes* he declared that "no phenomenon of nature has been omitted in the explanations given in this treatise."[28] To remove from himself the suspicion of conceit, Descartes resorts to a declaration which is perhaps the most characteristic expression of his anti-historicism. We hear him say that he considered himself luckier but not wiser than other thinkers: "If other persons have not discovered the same things as I have, it is entirely either because they did not turn their eyes in the proper direction, or because they did not concentrate their thoughts upon the same objects as I. I no more deserve to be extolled for having made these discoveries than a peasant who by chance has stumbled upon a treasure which for a long time had remained undetected by numerous searchers."[29] The followers of Descartes may or may not have shared his view that his intellectual achievements were nothing but lucky discoveries, but they certainly were convinced

[26] Descartes, *Discours de la Méthode,* 16.

[27] Descartes, *Méditations métaphysiques,* Epitre, 63. Cf. Kant: "The critical philosophy is subject to no fluctuations of opinion, to no improvements, and this philosophy rests upon a completely sure basis fixed forever and indispensable to all future generations for the best purposes of mankind." (*Erklärung in Beziehung auf Fichte's Wissenschaftslehre* in *Kants vermischte Schriften,* Kirchmann ed., 249.)

[28] Cf. *Discours de la Méthode:* "I dare assert that I noticed no object which I could not conveniently explain through the principles found by me" (49).

[29] *Recherche de la vérité par la lumière naturelle,* 385.

of the finality of his message, and hence of his wisdom. A typical illustration of this is offered by Malebranche. "The readers of Descartes will experience a secret joy in the realization that they were born in a fortunate age and country, saving us the trouble of hunting for a teacher of the truth in past ages and among pagans, in remote corners of the earth, among barbarians and foreigners."[30]

What Malebranche says about Descartes is almost repeated by Voltaire with regard to Locke and Newton. "Locke is the Hercules of metaphysics, who has fixed the limits of the human mind."[31] "Newton pushed his work to the most daring truths which the human mind could ever reach."[32]

The seventeenth- and eighteenth-century French poets and theorists of art were not hampered by metaphysical inhibitions concerning their profession. They found it easy to pay tribute to the spirit of their age by identifying the beautiful with the true and by preaching conformity with reason:

> Le vrai seul est aimable;
> Il doit regner partout, et même dans la fable.[33]

> Aimez donc la raison: que toujours vos écrits
> Empruntent d'elle seule et leur lustre et leur prix.[34]

The gospel of reason advocated by Boileau and his followers stood for the observance of proportion and moderation, for faithfulness to nature, or to what is normal, what can be generally understood and approved of. This faithfulness also meant compliance with models valid for all ages and societies. For writers like Boileau the source of these models was largely to be found in Greco-Roman literature, while for Voltaire it was mainly located in the poetic works of the age of Louis Quatorze. The following verses addressed by Boileau to writers engaged in idyllic poetry are typical in this respect:

> Suivez Théocrite et Virgile;
> Que leur tendres écrits, par les graces dictés,
> Ne quittent point vos mains, jour et nuit feuilletés.[35]

[30] Malebranche, *Recherche de la vérité,* II, 478.

[31] Voltaire, Letter to Horace Walpole, July 16, 1768, in *Lettres choisies* (Garnier Frères), II, 86.

[32] *Ibid., n.d.,* 230.

[33] Boileau, *Ep.* IX.

[34] Boileau, *L'Art Poétique,* Chant I.

[35] *Ibid.,* Chant II.

Voltaire, on the other hand, speaks of the perfect tragedies of Racine and the sublime scenes of Corneille, in comparison with which all the Greek tragedies seem to be school exercises.[36] Voltaire not only applies the epithet "perfect" to his favorite poetic works but also, in a truly unhistorical fashion, characterizes them as the first inventions of their kind. Thus we are told that Corneille "created the tragedy," and that Molière both "invented and made perfect the comedy, and that the works of the latter surpass the comedies of all ages."[37]

From a strictly rationalistic point of view the future is as irrelevant to the operations of reason as is the past. If it is true that reason admits of no degrees, that the works of reason are born, by good luck, perfect and full-fledged, then the past *qua* past is no more to be either extolled or denounced than the future *qua* future. Good luck would not be good luck if it had a special predilection for any particular instance of time. It is however a fact that such a strict and rigorous logic is scarcely adhered to by any of the protagonists of rationalism. Descartes was the first to violate this logic. At times he seems decidedly to favor the past at the cost of the future. According to a theological doctrine current in his day, human nature gets more and more corrupted with the passage of time, and reason consequently deteriorates.[38] Whether or not Descartes consciously adopted this version of the fall of man, there can be no doubt that he sometimes expressed himself in a manner greatly reminiscent of this dogma. We have seen him above insisting upon restoring reason as it is given to the individual by nature. As the ages pass by, so he argues, man is progressively plagued by book knowledge, a breeding-source for errors which corrupt the mind and dim the natural light of reason. Descartes goes so far in this direction as to assert that the naïve and simple-minded ancients, precisely because they were guided by the natural light of reason, formed true ideas about philosophy and mathematics, although they were yet unable to understand perfectly these sciences.[39]

[36] Voltaire, Letter to Walpole cited in note 31.

[37] Letter to Baron de Faugères, May 3, 1776; cf. also letter of note 32.

[38] Cf. Bouillier, *op. cit.*, I, 482–3. Bouillier does not quote directly from the author or authors of this doctrine, but refers to the writings of Arnauld, who vehemently attacked the thesis of the increasing corruption of reason. Curiously enough it did not occur to Bouillier that Descartes was himself tainted with this doctrine.

[39] Descartes, *Règles etc.*, 312.

Most frequently, however, Descartes speaks a different language. We have heard him declare above that the study of the past is a waste of time.[40] We also hear him say with regard to his own achievements that he would have arrived at his ideas and would have written what he wrote even had he never read anything.[41] This in itself does not of course involve a blanket repudiation of the past, and consequently a breach in the rationalistic position. All that it implies is the idea that the ancients were not lucky enough to have anticipated his views. Descartes, however, jeopardizes his rationalism when he asserts that it is the moderns who are the true ancients, because the world is older to-day and because we have more experience than our remote predecessors.[42] The predilection for the future implied in this assertion he sometimes carries to such an extent as to speak of the progress of science destined to bring about an ever growing amelioration of man's physical and moral nature.

The distinction occasionally drawn by Descartes between the past and the future became a clearly marked tendency in the hands of his followers. The idea that the moderns are the true ancients is again and again resorted to by Malebranche in order to vindicate the present and the future. The following is a typical statement on his part: "It stands to reason that we should regard Plato and Aristotle as more ignorant than the modern philosophers, because in the present age the world is two thousand years older, and because we have more experience than the ancients had."[43] This idea moreover formed the basis for the famous controversy which raged in the seventeenth century in France between the so-called moderns, or those who proclaimed the superiority of modern intellectual achievements over the works of classical antiquity, and the ancients, or those who maintained the converse view. The moderns were mostly recruited from the ranks of the Cartesians. Some of the moderns—Malebranche, Perrault, Lamotte—questioned the value not only of the philosophy and science but also of the poetry of classical antiquity. Others either confined themselves to extolling the immense progress achieved by modern philosophy and science (Arnauld, Nicole), or made an exception for the poetry of

[40] See above pp. 430, 432.

[41] Bouillier, *op. cit.*, 38.

[42] *Ibid.*, 482.

[43] Malebranche, *Recherche etc.*, I, 251.

classical antiquity by regarding art as not subject to the vicissitudes of time (La Bruyère, and particularly Fontenelle).[44]

It must be insisted again that the Cartesians' bestowal of a privileged status upon the future can scarcely be justified in terms of the rationalistic premises they held. To be sure, some of the seventeenth-century thinkers who called themselves Cartesians were really more empirical than rationalistic. But there can certainly be little doubt about the scant regard which both Descartes and Malebranche had for sense-experience. When therefore these two thinkers made experience as it grows in time yield a superior type of knowledge, and a superior metaphysical knowledge at that, they were obviously deviating from their doctrine of the self-sufficiency of reason. It is true that a greater stretch of time may bring about an increase in the number of individuals engaged in intellectual pursuits. But to be consistent with the principles of rationalism one should assert with Leibniz that a hundred persons judge no better than one person, just as a hundred horses run no faster than one horse.[45] Furthermore, to say, as Descartes suggests in his *Discours de la Méthode,* that in the past reason was unable to assert itself because of the dominance of the passions, is to indulge in a circular argument. For this is ultimately tantamount to maintaining that at certain periods of history people did not proceed rationally because they were then irrational. And to refer to lack of leisure as an obstacle in the path of reason is to disregard the fact that leisure is mostly a result of the rational organization of society.

The truth of the matter is that the peculiar attitude assumed by certain modern rationalists towards time was quite often motivated by considerations which had little to do with reason or logic. This was particularly the case with Malebranche. His opposition to the past was largely determined by several extra-logical factors. In the first place, to extol the past in general meant in his eyes to open the door to a competitor for the monopoly on tradition, which, as we have already seen, he had assigned to religious faith. To encourage the study of the past or of history, a discipline he thought utterly lacking in demonstrative evidence, thus meant for him to induce people to accept on faith traditions other than and directly opposed to those presented by Christianity. Malebranche

[44] Bouillier, ch. XXIII of vol. I.

[45] Leibniz, *Nouveaux Essais,* 469.

frankly appeals to psychology in order to show the pernicious effects which things of a hoary antiquity may produce upon the human mind. "There are numerous persons who look with so much curiosity and respect upon everything coming from antiquity . . . that their minds become enslaved, for we do not dare question and place ourselves above what we admire."[46]

In the second place, the past meant for Malebranche specifically the world of classical antiquity. In the enthusiasm for Greek and Roman literature, in the cult of classical learning and scholarship which had spread over the Western world ever since the days of the Renaissance, he saw a challenge to the moral outlook of Christianity. For he feared that an intimate association with this literature, gained through an intense study of its linguistic, geographical and other purely external aspects, might lead its devotees from a concern with form to an interest in content. In other words, what he feared above all was the possible contamination of the Christian public by the naturalistic, humanistic and secular spirit inherent in the classical world-view. He openly warns against the danger presented by the "wicked customs" of the ancient world to which persons not given to reflection might easily succumb.[47] Small wonder that we hear him declare that humanity would sustain no great loss if a fire were to destroy all the works of the ancient poets and philosophers.[48]

In the third place, the repudiation of classic antiquity served in the hands of Malebranche and of other Cartesians as a signal for a campaign to divorce Christian theology from the philosophy of antiquity, and especially, from that of Aristotle. The marriage between Aristotle's philosophy and Christian theology had been relatively easy to effect in the twelfth and thirteenth centuries. Science, which supplies theology with its cosmological doctrines, had scarcely advanced at that period beyond the position where Aristotle had left it. But this union had become extremely precarious in the seventeenth century, after most of Aristotle's scientific work had been discredited by the intellectual revolution that started with the Renaissance.[49] It is true that teleology occupied

[46] Malebranche, *Recherche etc.*, II, 210.

[47] *Ibid.*, I, 239.

[48] Bouillier, *op. cit.*, I, 481.

[49] How strong the reaction against Aristotle had become in the seventeenth century can be seen from the fact that Catholic thinkers like Arnauld and Nicole found

a central place in the philosophy of Aristotle, a circumstance particularly calculated to gratify a theology committed to a belief in a wise Providence. It must however be kept in mind that Aristotle's teleology was essentially an immanent one, and that in general all efficacy is for him domiciled within nature itself. And it was precisely the aversion for this dynamic naturalism that on the one hand determined to a large extent Malebranche's opposition to Aristotle,[50] and on the other made him as well as other Cartesians hail the mechanistic system of Descartes, which by divesting nature of all independent power lent itself to the implication that God is the sole active agent in the universe.

It is also true that certain aspects of Aristotle's cosmology, such as the geocentric doctrine or the conception of the hierarchical structure of the universe, harmonized well with scriptural accounts or with Christian dogmas. But the fact is that these supports for Christian theology were outweighed not only by the challenges raised by the new science against the whole structure of Aristotle's physics, but also by the presence in Christian theology of certain dogmas—the creation of the universe in time, the doctrine of the immortality of the human body as well as of the soul—which were in direct contradiction to the teachings of the Stagirite. Christian theologians always managed to handle recalcitrant facts or doctrines by resorting to rationalizations. Now if these theologians can with an easy conscience explain away, for instance, the Biblical imputation of human passions to God by asserting that the prophets knew better, but that they had to adapt themselves to the mentality of their audience, why should it not be legitimate to save the helio-centric doctrine by applying the same device to the famous order given by Joshua to the sun to postpone its setting? This is exactly what Malebranche does. Those who are puzzled by Joshua's order, he argues, "do not realize that the purpose of

it necessary to disown him in their *Port-Royal Logic,* a work which adhered closely to the principles and details of Aristotle's logical writings. In justification of their procedure they pointed out that Aristotle had forfeited the right to be respected, since truth requires a universal agreement which Aristotle's system no longer commanded in the chief countries of Europe. (Bouillier, *op. cit.,* II, 214.)

[50] Malebranche deplores the respect for pagan philosophy responsible for the pernicious doctrine that things can produce effects through their own natures. On the other hand, Descartes he extols for having recognized that "all natural laws concerning the communication of motion are nothing but the results of God's immutable will." (*Recherche de la vérité,* II, 323–5 and 358.)

the Bible is not to teach physics but to make itself understood, . . . that Joshua expressed himself before his soldiers in the same way as Copernicus, Galileo and Descartes would have done in conversations with ordinary people. . . . Do not the believers in the heliocentric doctrine say that the sun rises and sets when they speak to their valets or friends?"[51]

One who looks at things from the perspective of these seventeenth-century rationalists may legitimately ask the following questions: If so many theologians set themselves the task of squaring the Scriptures with philosophy, why must this philosophy be that of Aristotle, a thinker whose cosmology has become obsolete and whose moral outlook utterly lacks the austerity and otherworldliness so characteristic of Christian ethics? Why should not this philosophy be that of Descartes, a thinker who has constructed his system with an eye upon the church and whose scientific doctrines can satisfy both the learned and the unlearned? For is it not a fact that a Dutch follower of Descartes, Joannes Amerpool, gave the title of *Cartesius Mosaïzans* to a work in which he tried to establish the complete identity of the vortex theory with the account given in Genesis?[52]

Theological considerations, which as we have just shown played an important part in determining the opposition of certain Cartesians to the past, were also largely responsible for the insistence on the part of these thinkers upon the genuineness and even superior status of the future. It may seem rather odd to see conservative Catholic thinkers like Arnauld and Nicole champion the reality of the future in order to justify the occurrence of novelties. But this championship ceases to be strange when we discover that the novelty which mattered to them above all was the creation of the world in time. To deny the occurrence of novelties thus meant to them to contradict a fundamental Christian dogma.[53] It is also to save this dogma that Malebranche declares the universe to be finite with respect to the past and infinite and eternal with regard to the future. For to say, so he argues, that the world is eternal with regard to the past is to believe that things are independent of God, and is thus to question his power. On the other hand, to assert that the world is finite as to the future, and consequently to

[51] *Ibid.*, II, 112.

[52] Bouillier, *op. cit.*, I, 266.

[53] *Ibid.*, 482.

believe that it is subject to annihilation, is to doubt the constancy and immutability of God and to admit that he is susceptible of repentance.[54]

By whatever extra-logical considerations the Cartesians may have been guided, it is a fact that as early as the second half of the seventeenth century they stated in unmistakable terms the doctrine of progress and human perfectibility. A series of writers—Arnauld, Nicole, Perrault, La Bruyère, Fontenelle, Terrasson—formulate and re-formulate this doctrine. The empirically inclined Arnauld frankly admits that he is concerned not so much with reason, which for all he knows may be identical in all ages and in all human beings, as with its applications. He accordingly limits himself to stating that human knowledge becomes more perfect with time, and that modern philosophy and science are superior to those of the ancients.[55] Nicole takes his cue from the occurrence of novelties, which he infers from the large number of inventions made by human beings during the short period—4000 years—of recorded history.[56] For Perrault the idea of progress is verified by the advances made by the human mind since the creation of the world in the various sciences, in the crafts and arts, and in morals.[57] For most of these thinkers the idea of progress is not only a generalization derived from a survey of empirical data but also a deduction from a metaphysical theory. Thus according to Terrasson the progress of the human mind proceeds as naturally as the growth of plants or of other organic beings. The development of humanity follows for him a natural law similar to the one which makes an individual become wiser and more experienced as he grows older.[58] Most Cartesian advocates of the idea of progress, however, resort to cosmic explanations, which to be sure are nothing but introjections of biological analogies into the structure of the universe at large. We hear that the development of humanity corresponds to that of the universe, and that the latter goes through the stages of childhood, adolescence and manhood. Utilizing an idea current in the seventeenth century to the effect that the career of the human race can be imagined as analogous to that of a single

[54] Malebranche, *Recherche de la vérité*, II, 368; cf. also Bouillier.

[55] Bouillier, *op. cit.*, II, 153.

[56] *Ibid.*, I, 483.

[57] *Ibid.*, I, 485.

[58] *Ibid.*, I, 488.

individual who has been living from the beginning of time up to the present, Perrault asserts that "it stands to reason that this longeval individual should have been a child during the childhood of the universe, an adolescent during its adolescence, and should be a perfect man in the age of its maturity."[59] Other seventeenth-century writers, Fontenelle primarily, are not content with stating in general terms the scheme of the three stages; they also attempt to fill out these stages with a specific content. Thus Fontenelle declares that in its childhood humanity was absorbed in meeting urgent material needs; in its adolescence, a stage characteristic of classical antiquity, it devotes itself chiefly to the cultivation of objects pertaining to the imagination, such as art; in its maturity, which is represented by the present age, it is concerned above all with the pursuit of reason as expressed in the sciences.[60]

The seventeenth-century speculations about progress betray on the part of their authors a naïveté of approach and a scant realization of logical difficulties. The idea of novelty, which serves for Nicole as the basis for his belief in progress, is incompatible not only with the alleged self-sufficiency and timelessness of reason but also with the very purpose for which it was invoked. Unless one is ready to relegate all bad things to the past and reserve all good things for the future, one has no warrant for the belief that in the future things will become better and more perfect. But if one were going to make such an assumption, one would be bound to imply that the future is predetermined, at least so far as its direction is concerned, and in this way to jeopardize the belief in novelty.[61] Analogous considerations apply to the parallel drawn by the seventeenth-century writers between biological and cultural regularities.[62] If one has a right to speak about a natural law of growth, one should be entitled by the same token to refer to a

[59] *Ibid.*, I, 485.

[60] *Ibid.*, I, 486.

[61] It is worth noting that Malebranche also plays fast and loose with novelty and necessity. In order to account for the reality of time he resorts to Descartes' theory of continuous creation. He has however no qualms about bestowing upon God the constancy and immutability which he had removed from the material world.

[62] The belief in a correspondence between cultural and cosmic development has no logical connection with the doctrine of three stages. Extrinsically this belief was meant to square with the Biblical account, which synchronizes the emergence of man with the creation of the universe. Intrinsically it was evidently intended to endow cultural history with a regularity resembling that of the material world.

natural law of decay. Are not both growth and decay equally characteristic of organic beings? Similarly, it is obviously arbitrary both to stop with the stage of manhood and to identify the present age with this stage. Fontenelle seems to have been aware of at least a part of this difficulty. Instead, however, of attempting to solve this problem, he simply re-affirms his faith in human perfectibility and in the scheme of the three stages, as can be seen from the following: "It is too bad that this beautiful comparison [between biological and cultural development] cannot be pushed to its logical end. But I must admit that this individual, who is assumed to have lived from the beginning of time up to the present, will never experience old age, that he will always be able to perform the things pertaining to youth and particularly those suitable to manhood. In other words, to give up allegories, I must assert that mankind will never degenerate."[63]

The doctrine of the three stages, and particularly the identification of the present age with the highest stage of manhood, brings into a glaring light a clearly marked teleological orientation. For just as a child is from this point of view regarded as a potential man, so the earlier stages of historical development are justified as preparations for the later ones. It is true that an individual cannot reach manhood without passing through childhood. This however does not entitle us to assert that childhood has no intrinsic significance or value of its own. The assimilation of the history of humanity to the three stages revealed by the biological development of the individual thus implies that the past is to be evaluated neither in so far as it is important *per se,* nor in so far as it is capable of throwing light upon the present, but only in so far as it does not anticipate values cherished in the present.

II

The attitude towards history of another great rationalist, Leibniz, is more profound and also less consistent than that of Descartes and Malebranche. Like so many rationalists, Leibniz distinguishes sharply between a higher and a lower type of knowledge. The former expresses itself in what he calls truths of reason; the latter in truths of fact. The truths of reason are strictly universal and eternal; they constitute the basic principles of mathematics, metaphysics, ethics, jurisprudence, and natural theology. The truths

[63] Quoted from Bouillier, *op. cit.,* I, 487.

of fact have their source in the contingent, individual, local and temporal circumstances presented by sensations, memory, and experience in general. It is noteworthy that as a criterion for truths of reason Leibniz chose not the Cartesian psychological categories of certainty and evidence, but the strictly logico-mathematical ones of demonstrability and necessity. Demonstrability operates according to the law of identity, while necessity is governed by the law of contradiction (necessary truths are those whose opposites are self-contradictory).

These remarks serve to show in what sense Leibniz is or is not to be charged with the sin of anti-historicism. This sin manifests itself primarily in the fact that Leibniz leaves no place for historical considerations in dealing with truths of reason. He not only exempts these truths from all change and development but also assigns them a validity that cannot be affected by attempts to trace their origins back to non-rational sense-experience or by indications of their non-ubiquitousness or even non-existence. For sense-experience in Leibniz's view can serve only as the occasion for rational knowledge, or at best as verifying and exemplifying what has already been established by reason. It can never serve as proof. "If one has noticed these occasions [of scientific truths] and retained for posterity the memory of them—a very useful thing—such details would play a considerable rôle in the history of the arts but would not be adequate for making them the basis of systems."[64] Leibniz is equally explicit in insisting that the mere fact of the existence or non-existence of the truths of reason is no warrant for and no refutation of their logical justification. "The meaning of justice is independent of the existence of persons who practice it or in whose behalf it is performed, just as the relations obtaining between numbers would remain true even in case there were neither counting persons nor things to be counted."[65]

The distinction drawn by Leibniz between a realm of possibility as the source of timeless, necessary, and demonstrable propositions, and the world of existence as the home of temporal, contingent, and probable truths, plainly suggests a tendency that is compatible with a well-understood empiricism. For on the one hand recent scientific empiricists have been advocating the view

[64] *Nouveaux Essais* (Flammarion ed.), 364.

[65] Leibniz, *Hauptschriften zur Grundlegung der Philosophie* (hrsg. von Cassirer), II, 504.

that *a priori* propositions, or what Leibniz calls truths of reason, are not subject to experimental verification or refutation, that they are analytical and tautological since they are governed by the principle of identity or are true by definition. It is true that these empiricists have been confining these propositions to mathematics, whereas Leibniz finds them also in ethics, natural law, and natural theology. But this simply means that he has rendered a wider range of propositions tautological, and hence harmless. On the other hand, the Leibnizian distinction obviously implies the empiricistic thesis that history shares in the assets and liabilities of all existence. Leibniz actually declares that the "real existence of things that are not necessary is a matter of fact or of history."[66] If history is not a demonstrative and hence perfect science, it at least finds itself in respectable company, for we are told also that "physics in its entirety will never become a perfect science."[66a] Moreover, the fact that history deals with contingencies and probabilities does not, according to Leibniz, entitle us to deprive it of cognitive value. Unlike Descartes, he asserts that "opinion based on probability also deserves the name of knowledge," for Leibniz was perspicacious enough to realize that probability was not a matter of subjective opinion, but in his words "must be derived from the nature of things."[67] Surprisingly enough, he even goes on to say that he has "often been wondering whether the art of estimating probabilities would not be more useful than a large part of our demonstrative sciences."[68]

The fact is, however, that the Leibnizian system is shot through with inconsistencies. It would be out of place here to show how he first separates the realm of possibility from that of existence and then fuses the two, how he regards existential disciplines now as based on experience and then as grounded in reason, how he insists upon plurality, individuality, external relations, as well as upon universal interconnectedness, continuity and internality of relations. Suffice it to indicate that Leibniz most often identifies rationality not only with truths established demonstratively but also with purposiveness.[69] It is through teleology that he tries to

[66] *Nouveaux Essais*, 248.
[66a] *Ibid.*, 402.
[67] *Ibid.*, 320.
[68] *Ibid.*, 320.
[69] *Ibid.*, 425.

save for reason the things which in his empiricistic moods he was ready to regard as irrational. It is through teleology, which he imports under the dignified name of the Principle of Sufficient Reason, that he undertakes to show the rationality of the spatio-temporal world in general and of individual contingent things in particular, something which can be accomplished neither by logico-mathematical procedures nor by empirical knowledge. The Principle of Sufficient Reason can alone tell us why events happen the way they do and why things are what they are.[70] To be sure the Principle is not only teleological but also theological, for complete knowledge of contingent, individual, spatio-temporal existents, involving as it does an infinite number of factors, is possessed by God alone. God alone sees "the ground of all the predicates which can be truly asserted about a given person," so that "it is impossible for a limited intelligence to foresee accurately the course of events."[71] If this is the case, then human knowledge of matters pertaining to existence is not much furthered by the fact that God knows it all, and is therefore doomed to remain forever on a low empirical level. Nevertheless the true significance of the Principle of Sufficient Reason may be said to reside not so much in the question whether rationality is thereby achievable, as in the fact that it brings to light certain specific objectives having nothing to do with empiricism. For it is in an unmistakably teleological spirit that Leibniz asserts that the universe is an ordered whole and not a chaos, that everything in it is organically interconnected, that nature is uniform and constant in its operations.

Applied to history, the cardinal rôle assigned by Leibniz to final causes in his insistence upon uniformity, organic unity and coherence[72] makes for prediction, but also for a determinism so rigid and inclusive that no place is left for novelty or specificity. His pre-formationism[73] shows that there is no place for novelty and specificity in a system which assimilates the relation of cause and effect to that obtaining between ground and consequent, a system in which time, change, and development are logicized. "Temporal sequence forms a series, sharing with all other series

[70] For a statement of the principle of sufficient reason, cf. Leibniz, *Hauptschriften*, I, 124 and II, 443.

[71] *Ibid.*, II, 503 and 144; cf. also I, 91.

[72] *Ibid.*, II, 224.

[73] *Ibid.*, II, 248.

the fact that the law of the series already indicates the end which must be reached in our further progressions.''[74] Very little justice is done to change when Leibniz asserts that ''from the nature of particular things there follow results which are valid for a definite time.''[75] For in this view both the occurrence and the duration of the changes are predetermined by the structure or nature of the things under consideration. The pattern for all development is found by Leibniz in the unfolding of pre-existing potentialities which he ascribes to living things. ''Plants and animals spring from pre-formed seeds; they therefore represent nothing but transformations of pre-existing living beings.''[76] It is in agreement with this that he again and again asserts that the present is pregnant with the future. That these assertions meant for Leibniz more than the idea that our predictions have their basis solely in the evidence derived from our knowledge of the present and past, can be judged from the following: ''In virtue of metaphysical grounds everything in the universe is so connected that the present contains the future in its bosom.''[77]

Although Leibniz claims to have confined himself to an immanent teleology, he often speaks a language plainly betraying a crude anthropomorphism. ''If an object lends itself to advantageous uses, we can say with certainty that when God created it, he had in mind among other things these uses as a goal, that he foresaw them and aimed at them.''[78] It is this external teleology, the attempt to evaluate the past from the point of view of the ''advantageous uses'' which Leibniz reads into it, that characterizes his approach to the specific problems of history. He recommends the study, as well as an appreciative interpretation of ancient systems of philosophy, so as ''to make them as far as possible self-consistent,'' for this would serve as an antidote to the ''passion for destruction'' and ''vain quest for innovations,'' and would lead to firmly established propositions and to ultimate principles.[79] Again he attributes great importance to the study of sacred history as a support to the foundations of revelation.[80]

[74] *Ibid.*, II, 338.
[75] *Ibid.*
[76] *Ibid.*, 427.
[77] *Ibid.*, 75.
[78] *Ibid.*, I, 295.
[79] *Ibid.*, I, 256.
[80] *Nouveaux Essais*, 419.

Leibniz was one of the first to emphasize the importance of the comparative study of languages. He explicitly ridicules those philosophers who "speak with contempt of philology." "Since languages are the most ancient monuments of nations, antedating written documents and the arts, they serve best to show the origins, affinities and migrations of peoples."[81] This tends to suggest that the importance of philology lies for our philosopher purely in the satisfaction of intellectual curiosity. But the study of languages involved more than that for Leibniz. Realizing that German has many words in common with most of the ancient and modern European languages and even with Iranian, Leibniz jumps to the conclusion that these words are German, the mother of them all.[82] He accordingly appeals to his countrymen to cultivate and study their native tongue, because this would among other things redound to their glory, especially as it will become apparent that the origin and fountainhead of Europe's essence are largely to be sought among the Germans (*bei uns*).[83] Having assumed in common with most rationalists that human nature remains always and everywhere essentially the same, that virtue and vice cut across temporal boundaries, Leibniz regarded history as a school of practical wisdom disseminating and teaching useful lessons by examples. "I should like to see persons endeavoring to derive from history what is most useful, viz., extraordinary examples of virtue, accounts of what is conducive to good living, instances of political and military strategies. I should like to see a universal history written with such an end in view."[84]

III

It is noteworthy that a philosopher like Hegel who is reputed to be the apostle of historicism shared with these seventeenth- and eighteenth-century rationalists, and for similar reasons, their hostility towards so-called empirical history. Hegel explicitly declares that this sort of history belongs to the same class as natural history, geography, medicine, etc., disciplines which are essentially descriptive and which are determined not by reason but by the external play of contingencies.[85] Like the other rationalists Hegel

[81] *Ibid.*

[82] "Unvorgreifliche Gedanken, betreffend die Ausübing und Verbesserung der teutschen Sprache," in Leibniz, *Hauptschriften*, II, 533–4.

[83] *Ibid.*, 535.

[84] *Nouveaux Essais*, 420.

[85] Hegel, *Encyklop. im Grundrisse* (Rosenkranz ed.), 46.

believes that empirical history, based as it is on memory, testimony, etc., yields narrations and not demonstrations, and consequently has little or no cognitive value. When it comes to discredit things which he does not like Hegel becomes particularly squeamish and extra scrupulous. Thus he forbids empirical history to make any generalizations, to trace similarities between the present and the past, or to transcend what is immediately given. "Each temporal period is distinguished by such peculiar circumstances, presents so unique a situation, that all inferences drawn from it must be based exclusively upon the period itself."[86] In reality, however, there is for Hegel no such thing as an empirical history. He pokes fun at those writers who claim to be nothing but pure historians believing that it is possible to dispense with general philosophic considerations and to treat their subject in a completely impartial manner.[87] "Even the ordinary and mediocre historian who alleges that his attitude is purely receptive, and that he is guided exclusively by what is given, even he brings along with his thought categories of his own through which he sees existing conditions. He who looks at the world rationally is in his turn looked at rationally."[88]

To be sure, if by general philosophic considerations he understands interpretations of facts through theories and hypotheses, and if by partiality he means principles of selection guiding the historian in the labyrinth of his data, then all this is quite compatible with a well-understood empiricism, as we have pointed out above. Hegel, however, means something more than this. For we hear him assert that all history worthy of the name must be teleological, that purposes are indispensable in this discipline not only in the subjective sense as guiding the historian in the selection of his material, but also in the objective sense as expressing the rationality inherent in the events themselves. "A history without a purpose in this twofold sense would be an idiotic enterprise, not to be compared even with nursery tales, for even children demand that their stories should present an interest, that is, a purpose which can be guessed, and to which actions and events can be referred."[89] It is needless to point out that the distinction drawn

[86] *Philosophie der Geschichte* (Reklam ed.), 39.

[87] *Encyklop. im Grundrisse,* 452.

[88] *Philos. der Geschichte,* 44.

[89] *Encykl. im Grundrisse,* 453.

here by Hegel between objective and subjective purposiveness can scarcely be justified in the light of the subject-matter and function he assigns to history. For in this light the historian is to be guided in the selection of his material neither by the purpose at hand nor by the nature of his subject-matter, but by prescribed norms which tell him beforehand what to do and what not to do, and which ultimately have their roots in Hegel's own preconceived ideas. We hear him say that history must not be eclipsed by objects unworthy of it, by an intrusion of minor and particular occurrences. "The essential traits of the spirit of each age are always contained in major occurrences."[90] The historian would violate the ideal of objective truth, we hear Hegel argue, if he were to be concerned with the description and even with the authentication of truths about "external existences and contingencies." It is obvious that what is worthy and what is unworthy of historic treatment, what is major and what is minor, what is essential and what is unessential, what is external and what is contingent, are here determined by a normative scheme arbitrarily imposed upon the flux of events confronting the historian. It is equally obvious that a history complying with this program is anything but an empirical history.

Untenable as the Hegelian distinction between empirical and philosophical history[91] is, it nonetheless serves to focus attention upon certain methodological problems and concepts which transcend the narrow limits of traditional historiography, e.g., the ideas of continuity, progress, novelty, etc.

These methodological problems became central in the nineteenth century as a result of the attempts made by historians to give to their discipline a wider scope than that assigned to it by seventeenth- and eighteenth-century rationalists. The modern approach to history is characterized not only by the cumulative but also by the organic conception of history.

By the organic conception we understand the view that man's various cultural activities form an interconnected whole. Although this conception has gained wide currency in recent years through the work of Spengler, it was in fact clearly formulated by Hegel. The various cultural domains are in the words of Hegel expressions of a common substance or spirit. This substance is identified by

[90] *Ibid.*, 454.

[91] A similar distinction was made by Kant in his *Idee zu einer allgemeinen Geschichte, op. cit.*, 19.

Hegel mostly with what he calls the *Volksgeist*. "The *Volksgeist* is the common principle underlying the religion, political constitution, morality, legal system, science, and technical achievements of a given people."[92] The organic view on the one hand is a reaction against the vagueness and empty generalities of history conceived in universal and monistic terms. It stresses the uniqueness, specificity and plurality which characterize individuals of a higher cultural order, viz., historic epochs, national, class or racial groupings. On the other hand, this conception attempts to make of history a genuine science by differentiating it from a mere sequence of events, by endowing it with an inner coherence and rationality, and by insisting on the similarities obtaining among the diverse aspects of a given cultural whole.

The insistence on similarity implies that every aspect of a given culture expresses after its own fashion the spirit or essence of the whole, that it has bearings on every other aspect, e.g., disciplines like politics and technology are as essential to an understanding of metaphysics and religion or ethics as the latter are to an understanding of the former.

Consistently carried out the stress upon uniqueness implies that there are as many religions, philosophies and moralities as there are cultural wholes, and that it is as meaningless to speak of one universal religion or morality as it is to speak of one form of politics or art. Thus the organic view teaches us to regard ideas, beliefs, institutions as relative to determinate cultural contexts. It serves to warn us against the attempt to read modern ideas into ancient civilizations, against the belief that institutions can be freely transplanted from one age or culture to another, against the tendency to speak of the history of poetry or of philosophy in general.

The organic conception of culture is on the whole alien to the spirit of the seventeenth- and eighteenth-century rationalists. Their tendency to see embodiments of eternal truths not only in mathematics but also in ethics and jurisprudence, their belief in universalism as revealed in their doctrines of natural rights, the religion of reason, the unity of mankind—all this is directly antithetical to a pluralistic and relativistic conception of culture. Again, the habit of separating existence from essence, of origins

[92] *Philosophie der Geschichte*, 107.

from validity, expresses a formalism according to which the various cultural domains are entirely independent of one another, and are consequently to be understood exclusively in terms of their immanent structures.

So far as Hegel is concerned, it must be said that his philosophy of history is both inconsistent and ultimately self-defeating. First, he too extols eternal truths as the ultimate basis of all philosophy. Secondly, far from adhering consistently to the pluralistic conception of unique cultural wholes, he posits a supreme cultural constellation which presides over the destiny of the individual cultural wholes and towards which they all converge as their goal. "Europe is the goal of all history. . . . The Germanic principle is the reconciliation and solution of all contradictions." Hegel speaks not only of a *Volksgeist* but also of a *Weltgeist*. This implies that the relations between the various cultural monads are not external but internal, and that ultimately we are left with a cultural monism instead of the intended pluralism. But even if Hegel had faithfully clung to cultural pluralism, his organic conception of history would still be essentially anti-historical, and thus self-defeating. It is certainly true that Hegel had very little use for temporal development. Temporal distinctions, we hear him say, can have no interest for thought.[93] Such "poor" distinctions as past, present and future are asserted by him to have their proper place in the subjective realm of memory, fear and hope.[94] To base history on mere temporal change is, in his view, to offer us a spectacle of aimless drifting, of an external play of contingencies. He explicitly declares that the concept of evolution connoting temporal development or the temporal rise of higher biological species out of lower ones, is nebulous and unworthy of reflective thought.[95] In nature evolution can mean nothing but self-development.[96] Similarly, cultural development is ultimately of a logical nature, denoting an unfolding or actualization of potentialities. "Just as the seed or germ contains in itself the whole nature of the tree, the taste as well as the shape of its fruits, so do the first manifestations of the spirit contain the whole of history."[97] What takes place in

[93] *Werke* (Berlin, 1840), VII, 33.
[94] *Encyklop. im Grundrisse*, 217.
[95] *Ibid.*, 209.
[96] *Werke, op. cit.*, XIV, 305.
[97] *Philos. der Gesch.*, 52.

all development is, according to Hegel, a transition from the imperfect to the perfect, from the abstract to the concrete. It is true that development within a given culture requires time. But the duration, direction, and objects of this development are for Hegel determined beforehand by the existence of potentialities present from the very beginning. The fact that these cultural wholes or monads are characterized now as organisms, now as substances, plainly indicates he fashioned them after the pattern of either the prevalent pre-formistic biology of his day or of the traditional belief in timeless essences. Thus Hegel's organic philosophy of history far from doing justice to specificity and uniqueness turns out to be a rigid ironclad framework leaving no place for change and novelty, and consequently, for a genuine scientific approach to history.

While there are serious reasons for questioning the logical competence of the organic conception to yield an adequate foundation for history, the cumulative conception provides a more adequate scientific approach to history.

Hegel, undoubtedly, was the first to give a clear philosophic expression to the cumulative conception of history. It was Hegel who used the term "transcendence" to signify the fact that earlier stages of cultural process are surpassed but not annihilated, that they survive in a transfigured form. But at the same time it must be pointed out that insofar as he repudiated the idea of temporal development, he could not consistently adhere to the cumulative conception of history. For if he had taken the latter seriously, he would not have spoken of eternal truths, he would not have sung such paeans to the absolute truth with which philosophy is alleged to deal, nor would he have dismissed questions of origins as entirely irrevelant to the understanding of religion and even of law.

Finally, it is important to realize that with regard to the idea of progress, Hegel continued in the teleological rationalistic tradition. It is true that he repudiates the eighteenth-century belief in progress and the indefinite perfectibility of mankind, but this repudiation was grounded on his own teleological conception of history. The idea of infinite progress is for him the very embodiment of contradiction. The concept of infinite perfectibility in its turn "is as vague and indefinite as the idea of change in general."[98] The

[98] *Philosophie des Rechts* (Glockner ed.), 95.

notion of perfectibility is meaningless unless we specify a definite goal as a terminal point for all history. For the term infinite implies an open universe, whereas the concept of progress presupposes a closed and predetermined universe. It is noteworthy that Hegel exhibits the idea of progress as independent of time. For he is convinced that he can get rid of contradictions by conceiving development as oriented towards a definite goal, and by divesting the idea of progress of all temporal associations. Hegel indeed seems to achieve here a rational system in which freedom and necessity are organically synthesized. Freedom is secured by the presence of purpose, and necessity by the absence of time. It is, however, evident that the rationality achieved is of a kind from which Hegel would have shrunk in horror had be been willing or able to realize the full implications of his doctrine. For what we have here is a formally self-consistent and tautological system. It is needless to point out that Hegel's procedure is circular and arbitrary. He explicitly says that development to be meaningful must be conceived as guided by a purpose. But this is plainly tautological. Since purposeful is for Hegel equivalent to meaningful, this statement actually implies that development to be meaningful must be meaningful. Hegel is arbitrary here not only because of the specific goal—the triumph of the Germano-Christian world-view—which he makes the goal of history, not only because he was so naïve or so arrogant as to believe that the universe exists in order to bring about the triumph of the things he liked most, but also because he would have been just as arbitrary and circular had he selected any other goal. For to assign a goal to history essentially means to make history yield the things which have previously been put into it.

New York City

NOTES AND DOCUMENTS

THE AUTHENTIC TITLE OF COPERNICUS'S MAJOR WORK

By Edward Rosen

This year, in the midst of a globe-encircling war for the preservation of the basic rights of human beings, the civilized world pauses to honor the memory of the founder of modern astronomy. It was in 1543, exactly four hundred years ago, that the great treatise of Nicholas Copernicus was printed at Nuremberg under the title *De revolutionibus orbium caelestium* (Concerning the Revolutions of the Heavenly Spheres). The question has been raised whether this title was Copernicus's own choice, or was imposed upon his book by someone else without his knowledge or consent. In the main, the recent literature of the subject adopts the view that *De revolutionibus orbium caelestium* is not the authentic title. Against this verdict a protesting voice is lifted here and there. Under these circumstances an investigation of the whole problem of the title of Copernicus's volume may seem to our generation a not inappropriate method of celebrating the quadricentennial of the distinguished scientist.

I

It is well known that Copernicus, fearing the hostility of reactionary theologians, clung to his manuscript and long refused permission for its publication. Near the end of his life, however, he yielded to the entreaties of his friends and gave his consent. Did these friends promptly dispatch to Nuremberg, to be used as printer's copy, the manuscript which Copernicus had written out with his own hand (and which may be called the holograph)? It seems not. For the holograph has survived, and it shows no trace of having served as printer's copy.[1] Thus, its margins do not bear the numbered marks which typesetters usually put on handwritten copy to indicate the places corresponding to the end of a printed page and the beginning of the next. Moreover, it lacks the author's preface, which was drafted by Copernicus, as its contents show, only after he had agreed to publication. For these two reasons, apart from any others, it appears fairly certain that a fresh copy of the manuscript was made for the compositor, and that the preface was attached only to this apograph, which would be more legible than the holograph with its numerous deletions, alterations, and insertions.

[1] This opinion was rendered by Maximilian Curtze in *Archiv der Mathematik und Physik*, LIV (1872), literarischer Bericht CCXVI, 3. He had collated the holograph for the now standard Thorn edition of 1873, which was published in commemoration of the quatercentenary of Copernicus's birth. The Thorn editors accepted Curtze's judgment (see p. XVII of their Prolegomena).

But the transcript which was sent to the printer at Nuremberg has disappeared. Its loss is highly regrettable, since many troublesome problems would be instantly resolved with its aid. The missing handwritten sheets, unfortunately, cannot be reconstructed from the printed edition with complete confidence. For wholly apart from unintentional typographical errors, the author's manuscript was deliberately tampered with in the printer's office. Hence the fact that the Nuremberg edition was entitled *De revolutionibus orbium caelestium* is not in itself decisive. This title may have been selected by Copernicus, in which case it would have appeared on the apograph; or some other title may have been chosen by the author, only to undergo modification during the printing process.

On this question a mere flicker of light rather than a full, steady beam is thrown by the holograph. For it has no title page, and its first page carries no superscription of any sort, but starts at once with the text. In short, its beginning gives no indication whatever of the author's choice of title. Indeed, throughout its entire length it contains only a single clue to Copernicus's intention. This unique reference is an explicit, marking the close of one of the books into which the work was divided, and reading as follows: *Quintus revolutionum liber finit* (Here ends the fifth book of the *Revolutions*). Some scholars have felt that they needed no further evidence. In their eyes the situation was simple: the authentic title must be *De revolutionibus,* while the words *orbium caelestium* are extraneous.

But a little reflection will weaken the force of this conclusion. Suppose for a moment that Copernicus had adopted the longer title *De revolutionibus orbium caelestium,* and that he wished to designate the end of a book. What form would he give to his explicit? Is there any reason why *Quintus revolutionum liber finit* should not appear as an explicit in a work entitled *De revolutionibus orbium caelestium?* Surely, explicits did not always reproduce titles exactly. In fact, many an explicit was briefer than its title.[2] Hence the expression *Quintus revolutionum liber finit* might occur as an explicit, it seems to me, with equal propriety whether the volume bore the longer title *De revolutionibus orbium caelestium* or the shorter title *De revolutionibus.*

But the explicit under discussion is of importance in still another respect. We have just seen that it marks the close of Book V in the holograph. Yet this same passage terminates Book IV in the printed edition.[3] We are evidently dealing with two recensions, two distinct stages in the composition of a work which was many years in the writing. The earlier recension, of which we find traces in the holograph, divided the volume into a larger num-

[2] For two instances chosen at random, see *Gesamtkatalog der Wiegendrucke* (Leipzig, 1925–), 719, 2486. The Nuremberg edition, as we shall find later on, itself exemplifies this practice.

[3] See the Thorn edition, 306.

ber of books than the six adopted in the later recension or final form in which the work was published. In the earlier stage, very likely, Copernicus had not yet decided upon a formal title; hence the all but complete absence of a title in the holograph, which contains no hint of the author's name either. The necessity to frame a formal title arose only after he had overcome his reluctance to publish; and whatever title he selected appeared on the printer's copy, not in the holograph. But even if it is felt that the earlier recension must have had some title, that title need not have been identical in the two recensions. If, for example, the earlier recension was entitled *De revolutionibus,* Copernicus may well have added *orbium caelestium* in the final version. To sum up, the holograph by itself does not provide an unambiguous answer to the question, What is the authentic title of Copernicus's major work?

II

In a quest for further information we may turn to the author's friends and associates. During his declining years one of his intimates was George Joachim Rheticus, a young professor of mathematics who gave up his teaching post at Wittenberg University in order to learn the new astronomy from the lips of the master. Seeking to test public reaction to the innovations introduced by Copernicus, Rheticus published a survey of the system at Danzig in 1540.[4] The response was so favorable that a second edition of his *Narratio prima* was brought out in the following year at Basel. It is altogether likely that the welcome accorded to this little work was the clinching argument that finally persuaded Copernicus to release his manuscript for publication. Now although the titles of the two editions of Rheticus's treatise vary somewhat, they agree in describing it as a First Account of Copernicus's books on the Revolutions (*de libris revolutionum . . . Copernici . . . narratio prima*).[5] This reference by the disciple to his teacher's volume is virtually tantamount to calling it *De revolutionibus,* and cannot be restricted in its application to the earlier recension with its more than six books, since in the opening section of the *Narratio prima* Rheticus states that his "teacher has written a work of six books."[6]

Nevertheless, the testimony of Copernicus's foremost pupil does not decide the case. For in the title of his *Narratio prima* he patently does not cite Copernicus's work by its formal title. This may indicate that in the summer of 1539, when the *Narratio prima* was composed, a formal title had not yet been chosen; and if our reconstruction of the events leading up to the publication of Copernicus's work is not in error, the selection of a

[4] Mr. William Marshall Bullitt of Louisville, Kentucky, has kindly permitted me to examine his copy of the first edition of Rheticus's *Narratio prima.*

[5] The two titles may be conveniently compared in the Thorn edition, pp. XXIII–XXIV, or in Franz Hipler, *Spicilegium Copernicanum* (Braunsberg, 1873), 208–9.

[6] Edward Rosen, *Three Copernican Treatises* (New York, 1939), 109.

formal title was prompted by the warm public reception of the *Narratio prima*. In that case we should scarcely expect to find the formal title mentioned in a document which was drafted prior to the framing of the formal title. Before we lay Rheticus's little book aside, one further thought must detain us. Let us suppose once more that *De revolutionibus orbium caelestium* was the formal title. Planning to incorporate it in the cumbersome title of his own *Narratio prima*, would Rheticus perhaps have whittled it down?

III

Since neither the holograph nor Rheticus seems able to settle the issue for us, let us see how contemporaries reacted to the printed title. For instance, a copy of the Nuremberg edition was presented by Rheticus to George Donner, who was, like Copernicus, a canon of the cathedral chapter of Ermland, and one of the astronomer's staunchest friends. Now in Donner's copy, which is still preserved in the university library at Uppsala, a red line was drawn through the words *orbium caelestium* in the title.[7] In like manner the first two pieces in the book were stricken out. One of these is the false preface, of which we shall hear more below, while the other is a letter from Cardinal Schönberg urging Copernicus to publicize his discoveries. The purpose of the red lines, presumably, was to eliminate material not written by Copernicus. It would appear, then, that Donner (if he was indeed the person responsible for these cancellations) regarded *De revolutionibus* as the authentic title and *orbium caelestium* as an intrusion.

Again, in Rheticus's native town of Feldkirch there lived one of his best friends, a physician named Achilles Pirminius Gassar. A complimentary copy of Copernicus's book was sent to Gassar by the printer, probably at the request of Rheticus. At present this copy is on the shelves of the Vatican library, and the words *orbium caelestium* are blotted out of its title.[8]

The title of still another presentation copy, which reposes in the library of Leipzig University, was treated in the same way.[9] But since two of its owners have made it of the highest importance in the historical interpretation of the Copernican theory, we must trace its lineage carefully. This

[7] A photostatic reproduction of the title page of Donner's copy may be seen in Jeremi Wasiutyński, *Kopernik, twórca nowego nieba* (Warsaw, 1938), opposite p. 488; Stephen P. Mizwa, *Nicholas Copernicus* (New York, 1943), 29; and *Sky and Telescope*, II (May, 1943), 5. The call number of the Donner volume is given as Qq96 (Wasiutyński, 645).

[8] Adolf Müller, *Nikolaus Copernicus, der Altmeister der neuern Astronomie* (Freiburg im Breisgau, 1898), also printed in *Stimmen aus Maria-Laach*, Ergänzungsheft LXXII (1898), 148. Müller (4) gives the call number as Palatina III, 103.

[9] Its call number is given as Fol. Astron. 26 by Max Caspar, *Johannes Kepler, Neue Astronomie* (Munich, Berlin, 1929), 399.

ık is rendered all the more necessary because a distinguished scholar has, in my opinion, misconstrued the alteration of its title.

IV

The Leipzig copy was given in the first instance by the printer to Jerome Schreiber of Nuremberg.[10] Schreiber made a notation on it to the effect that the author of the opening address To the Reader, Concerning the Hypotheses of this Work (*Ad lectorem de hypothesibus huius operis*) was Osiander, not Copernicus. In the course of time Schreiber's copy came into the possession of John Kepler, the famous astronomer who discovered the three laws of planetary motion. Kepler was of course a confirmed Copernican, and he keenly resented Osiander's distortion of the doctrine. Citing Schreiber's handwritten notation, he publicly exposed Osiander as the author of the false preface.[11]

We should at this point turn back to recall how Osiander happened to occupy a position where he could foist upon unwary readers of Copernicus a grave misinterpretation of the author's basic ideas. The book was being printed at Nuremberg by John Petreius under the supervision of Rheticus. But the young professor had to leave for Leipzig, where he had accepted a teaching post at the university. Thereupon the task of guiding and advising the printer was undertaken by Andrew Osiander, a prominent Lutheran preacher and theologian who was interested in the mathematical sciences. From his correspondence with Copernicus two or three years before he had learned that they held conflicting conceptions of the nature of scientific method. He had in fact attempted to convert the astronomer to his own point of view, but with no success. Here he was, then, entrusted with the supervision of the printing of a book to which had been devoted the lifetime of a man with whose beliefs he disagreed, and who throughout this period lay sick and helpless in a distant land. Osiander suppressed the introduction written by Copernicus and replaced it by a preface of his own composition, from which he withheld his signature and to which he assigned the most prominent place possible in the volume, the verso of the title page.[12]

The brief document (which has been labelled the *Praefatiuncula* to distinguish it from the genuine preface, which is much longer) contained an

[10] The presentation inscription reads as follows: *"D. Hieronymo Schreiber / petreius dd. 1543"*; see Ludwik Antoni Birkenmajer, *Mikołaj Kopernik* (Cracow, 1900), 649.

[11] Kepler had the identification printed on the verso of the title page of his *Astronomia nova . . . de motibus stellae Martis* (Heidelberg, 1609); see p. 4 in the German translation of this book by Caspar (cited in n. 9, above), or the edition of Kepler's works by Christian Frisch (Frankfurt am Main, 1858–71), III, 136.

[12] For a translation of Osiander's preface and of the extant portion of his correspondence with Copernicus, see Rosen, *Three Copernican Treatises*, 22–25.

uncompromising statement of the view that astronomy cannot deal with reality or come to know the truth, and that astronomical theories are devised only to support calculations in agreement with the observational data. As an excellent expression of the fictionalist philosophy, according to which truth is unattainable in the natural sciences and by the scientific method, it stood diametrically opposed to the fundamental principles of Copernicus's book, in which the motion of the earth, to use the single most important example, was regarded as real, and truth as attainable. Confronted by the resulting contradiction between the false preface and the body of the work, many readers failed to detect the spurious authorship of the anonymous *Praefatiuncula* and permitted its alien ideas to pervert their understanding of the Copernican system. Although its extraneous character was recognized by Giordano Bruno, the leading proponent of Copernican concepts in the later sixteenth century, he could only describe its author as "some ignorant and presumptuous ass,"[13] because nine years before he would have learned Osiander's identity from Kepler's disclosure, he was condemned by the Roman Catholic church to be burned at the stake. In the history of science it is a fortunate circumstance that Kepler was able, through his ownership of Schreiber's copy of the Nuremberg edition, to reveal Osiander's misconduct and thereby diminish the harmful influence which the false preface exerted upon the reception of the new astronomy.

In the title of the Schreiber-Kepler copy, it will be remembered, the words *orbium caelestium* are deleted. Was it Schreiber who struck them out? Apparently not, for Kepler makes no mention of this cancellation, and the letters "E.W.L." were placed beneath it. To explain the alteration of the title of the Schreiber-Kepler copy, we must turn our attention to still another copy of the Nuremberg edition which came into the possession of Leipzig University under the circumstances recounted in the following note: "While Leonard Wolff, M.A., of Carniola was dean, this book was bought for the library of the arts faculty at a price of 28 florins, 6 pfennigs in the year 1543. L.W."[14] Now Wolff was dean in the winter semester of 1542, and his term of office expired in April or May, 1543.[15] Consequently the volume under discussion must have been purchased shortly after the edition came off the press. The dean evidently inscribed the new acquisition with the foregoing entry, which he initialled. At about the time when Leipzig University was buying its copy, the printer Petreius presented Jerome Schreiber

[13] *The Ash Wednesday Supper* (*La cena de le ceneri*), third dialogue, second proposition of Nundinio; see Bruno's *Opere italiene*, ed. Gentile, 2nd ed. (Bari, 1925–27), I, 66; for an English translation of the passage see the *Journal of the Warburg and Courtauld Institutes*, III (1939–40), 188.

[14] Birkenmajer, *Mikołaj Kopernik*, 647.

[15] *Codex diplomaticus Saxoniae regiae*, Part 2, Vol. 16–18 = Georg Erler, *Die Matrikel der Universität Leipzig* (Leipzig, 1895–1902), II, 669, 672–73.

of Nuremberg with a complimentary copy. As we have already seen, Schreiber's copy later passed into Kepler's ownership. Subsequently the Leipzig University library, having obtained the Schreiber-Kepler copy, sold the Wolff copy as a less valuable duplicate, but transferred Wolff's notation to the Schreiber-Kepler copy. For in this volume, which was retained, beneath Wolff's inscription a later hand recently wrote: "The above entry is taken from a second copy of this work which originally belonged to the Paulina and was auctioned off as a duplicate."[16]

If we have made no mistake in disentangling the history of both Leipzig copies, then we may reconstruct the events pertinent to our inquiry in the following way. Schreiber made no erasure in the title of his copy; hence Kepler is silent on the question of the title, and the Schreiber-Kepler copy came to Leipzig with its printed title unchanged. It was Wolff who had removed the words *orbium caelestium* from the title of his copy. When the Wolff copy was about to be sold, its annotations were transferred to the Schreiber-Kepler volume. During this process the title of the latter copy was modified for the first time, and the letters E.W.L., doubtless intended to indicate the authority for the change, may be presumed to stand for, say, *Emendavit* (or *Erasit*) *Wolff Leonardus* (Leonard Wolff is responsible for the emendation or erasure).

L. A. Birkenmajer, who first called attention to the Leipzig copy of the Nuremberg edition, was baffled by these three capital letters, for which he could offer no explanation. They might possibly be read E.W.S., he thought; yet, despite this uncertainty, he confidently identified the hand that wrote them with the hand that placed "Andreas Osiander" over the false preface. Now we have Kepler's authority for accepting the latter hand as Schreiber's. Hence Birkenmajer felt justified in attributing the change in the title to Schreiber.[17] But Kepler's silence in the matter of the title seems to me to be highly significant. If he had any reason to believe that the authentic title had been disturbed, and that Osiander was implicated, would he not have coupled a condemnation of the printed title with his denunciation of Osiander as the author of the false preface?

Before we take leave of the Leipzig copy, we should observe that Wolff's entry permits us to test the proposition that during the Reformation books

[16] *Mikołaj Kopernik*, 647. While Roman Catholic property was being confiscated during the Protestant reformation, the Dominican monastery of St. Paul in Leipzig was seized and turned over to Leipzig University in June, 1543. The expropriated books formed the nucleus of the university library, which was thereafter known as the Bibliotheca Paulina. But near the end of the nineteenth century the library was transferred to a new building named Bibliotheca Albertina after the reigning king of Saxony; see Eduard Zarncke, *Leipziger Bibliothekenführer* (Leipzig, 1909), 39, 42.

[17] *Mikolaj Kopernik*, 649, 651. He was uncritically followed by Wasiutyński, *Kopernik*, 511.

were cheap.[18] Printing presses had been in operation for almost a century, and the price of machine-made books was moderate in comparison with the prohibitive cost of manuscripts laboriously transcribed by hand. Yet in 1543, as Wolff informs us, the *Revolutions* sold for slightly more than 28 florins or gulden. Instead of attempting to estimate the modern equivalent in dollars and cents, let us see what 28 of these same florins meant to Rheticus. For teaching the higher grades of mathematics at Leipzig University during that academic year he received a stipend of 140 florins.[19] One-fifth of his fixed annual cash remuneration, in other words, would have been required to buy a copy of the *Revolutions*. Unless this work was exceptionally expensive, technical treatises must have been items of rather narrow distribution and high unit cost, in contrast to religious and literary books, which presumably were far more widely sold at very much lower prices. The financial position of a university professor of science must have been unenviable, if his salary enabled him to buy five professional books a year, and little else.

V

We must now consider the attitude toward *orbium caelestium* of the person to whom Copernicus referred in the genuine preface as "a man who loves me dearly." His account of his friendship with Tiedemann Giese, bishop of Kulm, suggests that their association extended to the intellectual plane. This impression is confirmed by Rheticus, who spent several weeks in their company. In the *Narratio prima* Giese is portrayed as a student of astronomy, especially interested in the improvement of the calendar, and as a collector of observational instruments. The bishop is depicted as having known Copernicus for many years and as having discussed with him the form in which the results of his scientific labors should be promulgated. To Giese, Rheticus assigned the principal credit for overcoming Copernicus's objections to publication. "By these and many other contentions, as I learned from friends familiar with the entire affair, the learned prelate won from my teacher a promise to permit scholars and posterity to pass judgment on his work. For this reason men of good will and students of mathematics will be deeply grateful with me to His Reverence, the bishop of Kulm, for presenting this achievement to the world."[20]

How did Giese react to the printed title of the book whose publication he was largely instrumental in securing? He received two copies of the Nuremberg edition from Rheticus, together with a message which unfortunately has been lost. Outraged at what his eyes beheld, he sent an indignant protest against the printer's misdeeds to the City Council or Senate

[18] Preserved Smith, *The Age of the Reformation* (New York, 1920), 468.

[19] Erler, *Die Matrikel*, II, 671, 697, 727.

[20] Rosen, *Three Copernican Treatises*, 109, 192–95.

of Nuremberg. He further enclosed a duplicate of his complaint in a letter to Rheticus, dated July 26, 1543, asking him to press the matter before the Nuremberg City Council. What provoked Giese's wrath? In his communication to Rheticus he says: "At the very outset I perceived the bad faith and, as you correctly phrase it, the impiety of Petreius, which stirred me to an anger that was darker than my previous grief [on learning of Copernicus's death]. For who would not be aroused by so shameful an act committed under the protecting cloak of trust? Yet I am not sure whether it should be blamed so much on this printer, who relied on the active guidance of others, as on a certain envious individual who, worried that he would have to abandon the ancient doctrine if this book won fame, perhaps took advantage of the printer's innocence to detract from the sincerity of the work. However, lest the printer escape without punishment after permitting himself to be misled by another's deceit, I have written to the City Council of Nuremberg, indicating what steps seemed to me to be necessary in order to restore the good faith of the author."[21] The Council referred Giese's letter to the printer Petreius, and upon receipt of his response came to the conclusion recorded in the following minute: "Wednesday, August 29. Send to Tiedemann, bishop of Kulm in Prussia, the answer written by John Petreius to the bishop's communication (the sharp tone of the answer should be eliminated and softened); add this comment: no action can be taken against Petreius in this matter in view of his reply."[22] The document in which the printer defended his conduct has unfortunately not been recovered.

The unnamed individual against whom Giese directed his main fire would appear to be Osiander. At any rate, this was the impression of John Broscius or Jan Brożek, a professor at Cracow University, who early in the seventeenth century published the Giese-Rheticus letter for the first time. Speaking of the false preface, Broscius remarked: "In his book on Mars Kepler designates Andrew Osiander as the author. And it is probable that Tiedemann Giese was angered by this preface when he poured forth the complaints which are extant in his letters." Broscius further declared that in one of the two copies of the Nuremberg edition sent to Giese by Rheticus he found Osiander's preface cancelled, but he made no mention of any alteration of the title. Yet we cannot accept Broscius as a thoroughly dependable reporter. For he had George Donner's copy also in his hands, and again he mentioned the cancellation of only the false preface.[23] But in this case

[21] The full text of this letter may be seen in the Warsaw (1854) edition of Copernicus, 640–41; *Zeitschrift für die Geschichte und Alterthumskunde Ermlands*, II (1861–63), 266–67; Hipler, *Spicilegium Copernicanum*, 354–56; and Leopold Prowe, *Nicolaus Coppernicus* (Berlin, 1883–84), II, 419–21.

[22] Birkenmajer, *Mikołaj Kopernik*, 403.

[23] *Ibid.*, 652–53. The comment quoted from Broscius appears in a marginal note to his copy of the Amsterdam (1617) edition of Copernicus, which was pre-

we happen to be able to check his statements; and, as we have already seen, the words *orbium caelestium* were deleted in Donner's copy. Unless we are prepared to suppose that this expression was stricken out after Broscius's examination, we must conclude that he neglected to note (or report) the change in the title. If he was guilty of this omission with regard to the Donner copy, we may well believe him to have been equally remiss with regard to the Giese copy; but in this latter instance we can neither verify nor discard his observation, since the Giese copy has apparently vanished. Nevertheless, to judge from the absence of any specific complaint against *orbium caelestium* in Giese's long letter of protest, the bishop would seem to have found nothing blameworthy in the printed title.

VI

We have thus far been able with some assurance to ascertain the varying reactions of five contemporaries. Three of them objected to the presence of *orbium caelestium* in the title, whereas the other two (Giese and Schreiber) did not. Of the three opponents, the first, George Donner, received his copy of the Nuremberg edition as a gift from Rheticus. The second, Achilles Pirminius Gassar, was singled out by Rheticus as that one of his former teachers who had encouraged him to take up the study of science. He expressed his gratitude in the dedication of his *Two Speeches,*[24] a small book which was printed by Petreius in 1542 while Copernicus's volume was on the stocks in that same establishment. But the teacher-pupil relationship developed into a cordial friendship. Thus Rheticus tells us that he inspected a work on magnetism in Gassar's home.[25] And in the foreword which Gassar wrote for the second edition (Basel, 1541)[26] of Rheticus's

served in the library of Cracow University under the call number Matem. 419. Attached to this volume was a notebook kept by Broscius, which contained his statements about the Giese and Donner copies.

[24] *Orationes duae, prima de astronomia et geographia, altera de physica* (Nuremberg, 1542); cf. Hipler, *Spicilegium Copernicanum,* 225, or Prowe, *Nicolaus Coppernicus,* II, 385.

[25] See his essay on chorography, first published in *Zeitschrift für Mathematik und Physik,* XXI (1876), historisch-literarische Abtheilung, 149.

[26] The copy of the first edition which Rheticus sent to Gassar in March, 1540 still survives in the Vatican library (see Adolf Müller's article on Rheticus in *Vierteljahrsschrift für Geschichte und Landeskunde Vorarlbergs,* II [1918], 18). Bound with it is the copy of Copernicus's trigonometry, *De lateribus et angulis triangulorum* (Wittenberg, 1542), which Rheticus likewise presented to Gassar. The volume containing both these works is shelved as Palatina IV, 585, according to Müller, *Nikolaus Copernicus,* 83–84. For other books given by Rheticus to Gassar, see Birkenmajer, *Mikolaj Kopernik,* 584–85. Gassar's foreword to the *Narratio prima* was reprinted in the Basel (1566) edition of Copernicus, 196v, and in the Warsaw

Narratio prima he referred to his former pupil as his fellow townsman and very good friend. Hence, when Petreius presented Gassar with a copy of his edition of Copernicus, he probably did so at the suggestion of Rheticus. The last of the three members of the opposition, Leonard Wolff, was dean at Leipzig University while Rheticus was teaching there. Now since each of the three objectors was more or less strongly influenced by Rheticus, the inference naturally emerges that the hostility to *orbium caelestium* perhaps emanated from Copernicus's chief disciple.

But even if this conjecture be valid, it must be acknowledged that Rheticus was also in touch with both Giese and Schreiber. His correspondence with the bishop after the publication of Copernicus's volume has already been discussed. He was personally acquainted with Schreiber too, since they had both been members of the entering class of Wittenberg University in the summer semester of 1532.[27] For reasons which we can now only surmise, Schreiber took an unusually long time to earn his master's degree, which he received in September, 1541, when Rheticus was terminating his prolonged visit to Copernicus.[28] Upon his return from Polish Prussia, Rheticus resumed teaching at Wittenberg University, serving as dean of the arts faculty during the early months of 1542. While he was dean, Schreiber was admitted to the faculty in April.[29] When Rheticus left Wittenberg that summer, Schreiber for a time replaced him, and subsequently sent a letter to him.[30] The two mathematicians moved in the same social circle. John Schöner, for example, to whom Rheticus addressed the *Narratio prima*, was also a friend of Schreiber's. Thus, when Schöner edited a group of three astronomical tracts by Peurbach and Regiomontanus for Petreius in 1541, he dedicated the volume to Schreiber;[31] and when Philip Melanchthon, after helping Rheticus to obtain a position at Leipzig University, wrote a

edition, 487–88; also in Kepler's *Mysterium cosmographicum* (Tübingen, 1596, pp. 90–92; Frankfurt, 1621, p. 94), Hipler's *Spicilegium Copernicanum*, 209–11, and Prowe's *Nicolaus Coppernicus*, II, 288–89.

[27] *Album academiae Vitebergensis*, ed. Karl E. Foerstemann *et al.* (Leipzig, Halle, 1841–1905), I, 145–46.

[28] Julius Köstlin, *Die Baccalaurei und Magistri der Wittenberger philosophischen Facultät 1538–1546* (Halle, 1890), 13.

[29] *Ibid.*, 21.

[30] *Corpus reformatorum*, IV (Halle, 1837), 854; V (1838), 47. The author of the letter is referred to by Melanchthon somewhat indistinctly as *"Hieronymus meus contubernalis."* But there can be little doubt that Schreiber is the individual in question, since half a year later Melanchthon described him as *"convivam meum"* (*Corp. ref.*, V, 177).

[31] See Birkenmajer, *Mikołaj Kopernik*, 236, and Ernst Zinner, *Leben und Wirken des Johannes Müller von Konigsberg, genannt Regiomontanus* (Munich, 1938), 251–52.

strong letter of recommendation for Schreiber, he declared that Schöner was ready to vouch for Schreiber's character and intellectual attainments.[32] Yet despite his associations with Giese and Schreiber, Rheticus somehow failed to elicit from them any expression of antipathy toward *orbium caelestium*.

VII

An additional approach to our problem is suggested by a copy of the Nuremberg edition in the library at Wolfenbüttel. On the title page of this Wolfenbüttel copy there is inscribed an unsigned note in a handwriting which is deemed to date from the late sixteenth century. This anonymous entry reads as follows:

> Copernicus derived the title of his volume from the passage in the *Hypotyposis* where Proclus mentions Sosigenes the peripatetic and his work Περὶ τῶν ἀνελιττουσῶν, that is, *De revolutionibus;* it was not Copernicus who added *orbium caelestium,* but someone else. In these six books Copernicus embraced the whole of astronomy, stating and proving individual propositions mathematically and by the geometrical method in imitation of Ptolemy.[33]

The unknown author of this comment was probably not unaware that such titles as *De revolutionibus nativitatum* and *De revolutionibus annorum mundi* appeared with some frequency at the head of astrological tracts. Yet his choice of Sosigenes as the source of Copernicus's title has much to commend it.

The treatise written by Sosigenes has been lost and its title has survived, so far as I know, only because it is mentioned on this one occasion by Proclus.[34] But the Greek text of Proclus's *Hypotyposis* was first printed at Basel in 1540. Although it appeared before Copernicus's last illness set in, there is no positive evidence that he ever had the original Greek of Proclus before him. However, while Copernicus was still a student in Italy, the *Hypotyposis* was rendered into Latin by George Valla, who incorporated his translation in his *De expetendis et fugiendis rebus* (Venice, 1501). We have adequate reason, on other grounds, to believe that Copernicus actively utilized Valla's encyclopedic tome.[35] It is likely, then, that Copernicus knew the Latin version of Valla rather than the original Greek of Proclus.

The passage of crucial importance for us was translated by Valla as

[32] *Corpus reformatorum,* IV, 815; V, 39.

[33] Prowe, *Nicolaus Coppernicus,* Vol. I, Part II, 541–42; Prowe gives the Wolfenbüttel call number as 21.1. Astron. fol.

[34] *Hypotyposis* iv.98 (ed. Manitius, Leipzig, 1909, p. 130.18–19); for an English translation of the passage see Thomas L. Heath, *Aristarchus of Samos* (Oxford, 1913), 223.

[35] L. A. Birkenmajer, *Stromata Copernicana* (Cracow, 1924), 153–68.

follows: "*hoc si verum, non est verum quod Sosigenes narrat peripateticus in eis quae de revolutionibus inscripsit.*"[36] (If this is true, then that is not true which is asserted by Sosigenes the peripatetic in the work which he wrote *De revolutionibus*). This is the expression which may have suggested his title to Copernicus. But may he not have sought a distinctive title for his own volume by differentiating it from that of Sosigenes's lost work?

That title, it should be observed, was not translated by Valla with precision, for *De revolutionibus* does not convey quite the same idea as Περὶ τῶν ἀνελιττουσῶν. The last word is participial in form, and implies "spheres" as the noun to which it should be attached in thought. It was part of the technical vocabulary of the theory of homocentric or concentric spheres, and was applied by Aristotle specifically to the counteracting spheres which he devised to fill what he regarded as a gap in that theory. From his predecessors he had accepted thirty-three "carrying" spheres, as he called them, and to these he felt obliged to add twenty-two "counteracting" spheres.[37] In the course of time his followers, the peripatetics, abandoned the homocentric system for the rival doctrine of eccentrics and epicycles (of which Copernicus must be reckoned an adherent). In this process the term which had formerly been restricted to the counteracting spheres came to embrace both the original carrying spheres which Aristotle had inherited and the counteracting spheres which he introduced. After this distinction had become blurred, the word meant, in a general way, "the revolving spheres." It was manifestly this later, more general sense which Valla attached to it, rather than the earlier, more specific sense.[38] On the older interpretation, Περὶ των ἀνελιττουσῶν signified "Concerning the counteracting (spheres);" on the later, "Concerning the revolving (spheres)." What an outstanding authority of Copernicus's time thought of Valla's translations is recorded in the following judgment: "Not only did Valla conceal his numerous borrowings from Greek authors, but in his Latin versions of them he made many mistakes."[39]

Copernicus probably never learned what Greek expression lay beneath Valla's *De revolutionibus,* if the 1540 Greek text of Proclus failed to reach him. But Rheticus unquestionably made its acquaintance, since in the summer semester of 1546 at Leipzig University he was scheduled to lecture on the *Hypotyposis* in the original Greek.[40] Moreover, in 1550 at

[36] *De expetendis et fugiendis rebus,* Book XVIII, fol. ff5v.

[37] *Metaphysics* xii.8 1073b17–1074a12.

[38] These two stages in the development of the term were distinguished by Giovanni Schiaparelli in his article, "Le sfere omocentriche di Eudosso, di Callippo e di Aristotele," reprinted in his *Scritti sulla storia della astronomia antica* (Bologna, 1925–27), II, 95–96.

[39] Conrad Gesner, *Bibliotheca universalis* (Zürich, 1545), 273r; in the 1583 edition this adverse comment is missing (277).

[40] Erler, *Die Matrikel,* II, 690.

Leipzig he published an ephemeris, in the preface to which he used Περὶ τῶν ἀνελιττουσῶν unmistakably to mean "concerning the revolution." Likewise, in the title of his ephemeris he so employed this Greek phrase as to imply that it was the equivalent of Copernicus's title.[41] Consequently, when the writer of the anonymous Wolfenbüttel note in his first sentence incorrectly identified the Greek text of Proclus as the immediate source of Copernicus's title, he was probably making an inference based on Rheticus. This probability is heightened by the fact that his other sentence is an unacknowledged quotation from the opening section of Rheticus's *Narratio prima*.[42]

VIII

It will be recalled that, according to the Wolfenbüttel entry, "it was not Copernicus who added *orbium caelestium*, but someone else." This blank space in the indictment was filled in by Johann Gabriel Doppelmayr, an eighteenth-century historian of the Nuremberg intellectuals. In his *Historische Nachricht von den nürnbergischen Mathematicis und Künstlern* (Nuremberg, 1730) Doppelmayr aired the controversy over Copernicus's title for the first time in print and flatly charged Osiander with inserting the two words contrary to Copernicus's intentions or, as he put it, "wider des Copernici Sinn."[43] Let us take his accusation under advisement. We are informed that the man who supervised the printing deliberately and willfully expanded the title from *De revolutionibus* to *De revolutionibus orbium caelestium*. Now what does the corpus delicti disclose? The Nuremberg edition carries the longer title in two places only, on the title page and over the table of contents. On the other hand, the shorter form occurs over the genuine preface, at the beginning of each of the six books, in the explicits of the last three books (Books II and III have no explicit, while Book I has simply *Finis primi libri*) and in the running head. In other words, of the 207 spots where indications of the title appear, only two show *De revolutionibus orbium caelestium*, whereas all the rest give *De revolutionibus*. In the face of these facts must we not in all fairness acquit Osiander of the baseless charge that he tampered with Copernicus's title?

How did Doppelmayr come to level this accusation against Osiander? The story of the Lutheran minister's falsification of the preface, it will be remembered, had been published by Kepler more than a century before,[44]

[41] The title and preface of Rheticus's ephemeris may be examined in the Warsaw edition of Copernicus, 548, 552; Hipler, *Spicilegium Copernicanum*, 225, 231; and Prowe, *Nicolaus Coppernicus*, II, 387, 396.

[42] See Rosen, *Three Copernican Treatises*, 109–110.

[43] Page 60.

[44] Kepler's fuller statement of the case against Osiander remained unknown to Doppelmayr, because it formed part of his *Defense of Tycho* (*Apologia Tychonis contra Ursum*). This essay he left uncompleted; it was first published in 1858 in Frisch's edition of his works, I, 245–46.

and his account of the affair was inserted half a century later in a biography of Copernicus by Gassend.[45] This biography was undoubtedly Doppelmayr's source for the Osiander episode, since in this context he cites Gassend by name twice[46] and generally exhibits an unmistakable dependence upon the French philosopher-scientist. Yet neither Gassend nor Kepler before him had taxed Osiander with disfiguring the title; in fact Gassend had explicitly attributed the full title to Copernicus.[47] Having evidently heard in some other quarter an echo of the attack upon the authenticity of *orbium caelestium,* Doppelmayr arraigned on this additional charge the man who had already been convicted of inserting the false preface.

The Nuremberg bio-bibliographer's contribution to the case against Osiander has turned out to have no basis in fact. But his accusation is worse than gratuitous. He understood correctly that Osiander had insinuated the false preface in order to misrepresent Copernicus's ideas. Erroneously supposing that the same culprit had also tampered with Copernicus's title, he assumed a similar motive for the alleged action. Thus he states that Osiander tacked on *orbium caelestium* in the interests of greater security ("zur bessern Sicherheit").[48] Why did he think that these two words would turn away wrath? What was their meaning in Copernicus's time?

The expression *orbium caelestium* referred, not to the visible stars and planets, but to invisible celestial spheres, which had formed an integral part of astronomical theory from the days of the Greeks. Like his ancient and medieval predecessors, Copernicus regarded an observable planet, Mars for instance, as situated, like a spot or point, on the surface of such an invisible sphere. The planet was deemed to have no independent motion of its own, but simply to participate in the motion of the sphere to whose surface it was attached. Copernicus neither doubted nor denied the existence of these celestial spheres.[49] For him, as for his predecessors and contemporaries, they constituted essential parts of the universe. In this aspect of cosmological theory he made no departure from the established tradition. We may consequently expect to find the words *orbium caelestium* in the body of his treatise, and we are not disappointed. For example, the tenth chapter of the first book is entitled *De ordine caelestium orbium* (Concerning the Order of the Heavenly Spheres). Again, in the genuine preface Copernicus says that he sought better explanations of the revolution of the celestial spheres

[45] See his *Life of Tycho Brahe* (Paris, 1654; reprinted, The Hague, 1655), 36, or his *Opera omnia* (Lyon, 1658), V, 510.

[46] Prowe's statement that "Doppelmayr does not give his authority" may be disregarded (*Nicolaus Coppernicus,* Vol. I, Part II, 541).

[47] *Life of Brahe,* 14, or *Opera,* V, 502.

[48] Page 60.

[49] See Alexandre Koyré, *Nicolas Copernic, Des révolutions des orbes célestes* (Paris, 1934), 139.

(*revolutione orbium caelestium*). Hence the words *orbium caelestium* were actually employed by Copernicus to express one of his basic concepts.

Now Doppelmayr was apparently aware that the astronomical achievements of the seventeenth century, particularly those of Kepler, Galileo and Newton, had banished the imaginary celestial spheres forever from the real heavens. He likewise knew that these titans were all Copernicans. Hence he falsely assumed, without investigation, that Copernicus also rejected the celestial spheres. To his mind, then, the intrusion of *orbium caelestium* in Copernicus's title at one and the same time misrepresented Copernicus's ideas and thereby provided protection against contemporary prejudice.

IX

The erroneous conclusions of Doppelmayr exerted a powerful influence upon later writers about Copernicus. Thus Abraham Gotthelf Kästner, author of a history of mathematics from the Renaissance to the end of the eighteenth century, on Doppelmayr's authority declared Osiander guilty of expanding the title.[50] Then in the nineteenth century three historians of astronomy, a German, a Swiss, and an Englishman, Ernst Friedrich Apelt,[51] Rudolf Wolf,[52] and Arthur Berry[53] spread the fable further. It was accepted also by Moritz Cantor in his widely read history of mathematics.[54] Many specialists in Copernican studies believed the tale; for example, Maximilian Curtze,[55] chief editor of the Thorn edition of 1873; Franz Hipler, author of a valuable collection of papers relating to Copernicus;[56] Carl Rudolf Menzzer, the German translator of Copernicus;[57] Leopold Prowe, the leading German investigator;[58] Ludwik Antoni Birkenmajer, the foremost Polish authority;[59] Jeremi Wasiutyński, a recent Polish writer;[60] and Dorothy Stimson, author of a doctoral dissertation on the history of Copernicanism.[61] Preserved Smith incorporated the fiction in his *History of Modern Culture*.[62]

[50] *Geschichte der Mathematik* (Göttingen, 1796–1800), II, 367.

[51] *Die Reformation der Sternkunde* (Jena, 1852), 159.

[52] *Geschichte der Astronomie* (Munich, 1877), 238–39.

[53] *A Short History of Astronomy* (London, 1898), 99.

[54] *Vorlesungen über Geschichte der Mathematik,* Leipzig, Vol. II; 1st ed. (1892), 431; 2nd ed. (1900), 469–70.

[55] *Archiv der Math. und Physik,* LIV (1872), lit. Bericht CCXVI, 3.

[56] *Spicilegium Copernicanum,* 362.

[57] *Nicolaus Coppernicus, Über die Kreisbewegungen der Weltkörper* (Thorn, 1879), note 1.

[58] *Nicolaus Coppernicus,* Vol. I, Part II, 541.

[59] *Mikołaj Kopernik,* 411.

[60] *Kopernik, twórca nowego nieba,* 476–77.

[61] *The Gradual Acceptance of the Copernican Theory of the Universe* (Hanover, New Hampshire, 1917), 26.

[62] I (New York, 1930), 22.

A second group of writers believed that *orbium caelestium* formed no part of the authentic title, but refrained from identifying the person responsible for the intrusion. This group includes Antonio Favaro,[63] the editor of Galileo's collected works; Phillips Russell, a contemporary American writer of popular biography;[64] Eugen Brachvogel, perhaps the outstanding German student of Copernicus in our time;[65] and two recent British writers, Abraham Wolf[66] and Angus Armitage.[67]

The third and only remaining position adopted by modern writers who have expressed an opinion on the subject is that there are no sound objections to *orbium caelestium*. This category consists of Johann Christoph Gartz, who wrote the article on Copernicus in the *Allgemeine Encyclopädie* of Ersch and Gruber;[68] Franz Beckman, who published a series of articles on the history of the Copernican system in the *Zeitschrift für die Geschichte und Alterthumskunde Ermlands;*[69] and John Louis Emil Dreyer, the twentieth-century Danish historian of astronomy,[70] who edited the complete works of Tycho Brahe.

X

Before proceeding to formulate our own conclusions we should again recall the natural human tendency to cite a long title by some shortened form. A striking illustration of this habit is provided by an inscription on a flyleaf of the holograph. That invaluable document is preceded by three preliminary pages, of which the first is blank, while the recto of the second bears the following entry:[71]

"This is the work *De revolutionibus caelestibus*, as it was written out in his own hand by that venerable and distinguished doctor of both laws, Nicholas Copernicus, canon of Ermland in German Prussia, a celebrated

[63] See *Bullettino di bibliografia e di storia delle scienze matematiche e fisiche*, ed. Boncompagni, XII (1879), 803–4, where Favaro reported on an article which Curtze had published in both the *Archiv d. Math. u. Phys.*, LXII (1878), and the *Mittheilungen des Coppernicus-Vereins für Wissenschaft und Kunst zu Thorn*, I (1878). In this article Curtze failed to name the miscreant (*Archiv*, 349; *Mitt.*, 46). Perhaps Favaro was unaware that Curtze had previously put the blame on Osiander (see n. 55, above).

[64] *Harvesters* (New York, 1932), 79.

[65] *Zeitschrift f. d. Gesch. u. Alt. Ermlands*, XXV (1933–35), 698.

[66] *A History of Science, Technology, and Philosophy in the 16th and 17th Centuries* (London and New York, 1935), 13.

[67] *Copernicus* (London, 1938), 63–64.

[68] Vol. XIX (1829), 252, n.14.

[69] II (1861–63), 332, n.47.

[70] *History of the Planetary Systems from Thales to Kepler* (Cambridge, 1906), 321, n.2.

[71] Thorn edition, pp. IX–X.

mathematician. It was previously preserved in the library of George Joachim Rheticus, then of Valentine Otho, and on December 19, 1603, was obtained for the use of the mathematics department by Jacob Christmann, dean of the arts faculty."[72] From this note we learn that the holograph passed from Rheticus to his younger collaborator, Lucius Valentine Otho, and then in turn to Christmann at Heidelberg University.[73] Christmann pasted on the back of the binding a label reading: "Nicholas Copernicus's work, *De revolutionibus caelestibus,* written out in his own hand."[74] In both his references to the title, then, Christmann cut it down to *De revolutionibus caelestibus.* But the short form generally preferred through the centuries was *De revolutionibus.*

Bearing this preference in mind, we may reflect back over the various phases of our inquiry and recapitulate our main results. Six propositions stand out as perhaps the most significant.

(1) In all likelihood it was only after Copernicus had agreed to publish that he selected a formal title.

(2) Whether this was *De revolutionibus orbium caelestium* or *De revolutionibus* cannot be determined with absolute certainty.

(3) In either case his immediate source was probably George Valla's translation of Proclus's citation of the title of Sosigenes's lost work.

(4) The strong and widespread contemporary opposition to *orbium caelestium* seems to have emanated from Rheticus.

(5) There are no valid doctrinal or stylistic objections to *orbium caelestium.*

(6) Osiander did not falsify the title.

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[72] Christmann was made dean on December 20, 1602, and his successor was designated on December 20, 1603; see Gustav Toepke and Paul Hintzelmann, *Die Matrikel der Universität Heidelberg* (Heidelberg, 1884–1916), II, 472.

[73] For the subsequent history of the holograph see Quido Vetter, "Sur les destins du manuscrit pragois du Kopernik," in *Mémoires de la société royale de Bohême,* classe des sciences (1931).

[74] Thorn edition, p. XI; cf. Curtze in *Altpreussische Monatsschrift,* IX (1872), 188.

SAINT-SIMON, THE UTOPIAN PRECURSOR OF THE LEAGUE OF NATIONS

By Elliot H. Polinger

I

Over a hundred years ago, in 1814, at the end of the Napoleonic Wars, the utopian Count Claude-Henri de Saint-Simon with a keen prescience of mind proposed to the Parliaments of France and England that the two countries internationalize their institutions, proclaim the equality of the French and English people, ally their industries, their commerce, their navies, their parliaments, and have but one paper money for both countries guaranteed by an Anglo-French circulating bank. Saint-Simon dreamed of his plan as the point of departure of a league of nations, which would outlaw cataclysmic war and ensure perpetual peace. His ideas were laughed at by the English and dismissed by the French as mad. Oddly enough and similarly, at the outset of the present world war Winston Churchill, in his efforts to turn back a flood, addressed France, offering to pool resources with his erstwhile ally, but the extended hand was coolly received and finally rejected. History repeats and reverses itself while scorched humanity looks on helplessly.

Saint-Simon (1760–1825), who straddled the French Revolution and the rise of industrialism, was no stranger to the United States. At the age of nineteen he had graced our American shores as captain in a cavalry regiment in 1779 and served our cause brilliantly in the Revolutionary War. For distinctive service in five American campaigns dating from 1779 to 1783, Saint-Simon was inducted into the Order of the Cincinnati, a hereditary order founded in 1783 by officers of the War of the American Revolution. Later he wrote: "I found myself at the siege of York; and I contributed in a rather important manner to the capture of General Cornwallis and his army. So I may regard myself as one of the founders of the liberty of the United States; for it was that operation which, in determining the conditions of peace, fixed irrevocably the independence of America."[1]

Tutored by d'Alembert, the co-editor of the French *Encyclopedia,* and steeped in the great social principles of that monumental work, Saint-Simon was able to appreciate the struggle for democracy taking place in America, and prophesied with acumen that "the American Revolution signaled the beginning of a new political era, that this revolution was to determine necessarily important progress in civilization and that shortly it would cause great changes in the social order then existing in Europe."[2]

[1] *Lettre à un Américain* (1817), 23; in *Lettres américaines.*

[2] *Lettres d'un habitant de Genève à ses contemporains* (1803), XXII, *sq.* Introduction by Alfred Pereire.

To understand thoroughly a sensitive thinker like Saint-Simon, who was also imbued with the scientific spirit, we must realize that a brain like his was not tolerant of small schemes, but was filled imperiously with colossal projects, which would tend to facilitate industrial and commercial relations throughout the world, thus serving as a basis for lasting peace. So much so that before leaving America, he offered a far-sighted project to the viceroy of Mexico to improve trade negotiations—namely, the digging of a canal to join the Atlantic to the Pacific. He had visualized clearly the possibilities of the Panama Canal. The viceroy received his proposal coldly; but rebuffs were to mean nothing to Saint-Simon, for he was to go on digging deep into the human deposit right through life.

After his return to France in 1783, Saint-Simon made plans to travel about in Europe. In 1785 we find him in Holland, and in 1787 in Spain, amassing diverse information, which led him to write that his life was but a "series of experiences." It happened that the Spanish government was planning a canal from Madrid to the sea. It needed money and laborers. Therefore, in concert with Count de Cabarrus, French director of the bank of Saint-Charles, Saint-Simon prepared to lend the Spanish government the financial means to carry out its scheme. Unfortunately, he was caught in the maelstrom of onrushing historical events. The French Revolution, which had just broken out, interrupted the grandiose project and brought him scurrying back to France, which was burning with the red heat of crisis.

The Count, who sympathized deeply with the basic principles of liberty, equality and fraternity, renounced both his nobility and his name, and became the simple citizen Monsieur Bonhomme. Presiding over the assembly of the town of Falvy in 1790, he announced to the citizens that "there are no more lords; we are all perfectly equal here." The Count had been metamorphosed into a true *sans-culotte*.

Always on the alert to engage in some sort of business, he envisaged during the Revolution the opportunity of speculating with national property and grasped the possibility of buying land for development as an aid to the peasant. In fact, Saint-Simon himself explained that "he wanted a fortune only as a means to organize a great industrial establishment . . .; to contribute in a word to the progress of enlightenment and to the amelioration of humanity. . . ."[3] He associated himself with the former ambassador of Prussia to Spain, a certain Count Redern, who supplied the financial backing. Despite his idealistic pronouncements Saint-Simon bought and sold land quite profitably. However, his fruitful transactions were brought to an abrupt end by the Reign of Terror. Denounced by the Revolutionary Committee of Péronne on October 8, 1793, as an ex-noble associated with a foreigner in land speculations, Saint-Simon was thrown

[3] *Oeuvres complètes*, I, 67.

into the Luxembourg Prison, "the anti-chamber of death." Although threatened with imminent extinction he conducted himself with equanimity, defended himself courageously and finally proved that he had always professed good citizenship—whereupon he was freed.

In 1797 he quarreled with his business partner Count Redern, and as a result their real-estate venture was dissolved, leaving Saint-Simon comfortable with a good sum of money. For several years he devoted himself to extensive reading and to a broad study of physics and physiology, while holding open house—amid an exhilarating atmosphere and innumerable convivial dinners—to scholars and to scientists, among whom we find such distinguished names as Comte, Cabanis, Cuvier and Lamarck.

On learning that the brilliant Madame de Stael had just become a widow, Saint-Simon divorced his wife—with whom he had had a mutual agreement for just such a contingency—and set out for Coppet, Switzerland, where he explained to the ineffably charming Madame de Stael his plans for social reorganization while paying her arduous court. He even made her the following munificent advance: "Madame, you are the most extraordinary woman in the world, as I am the most extraordinary man; together we would undoubtedly have an even more extraordinary child."[4] However, she was far too occupied with the impassioned novelist Benjamin Constant at that moment to take Saint-Simon's offer of marriage seriously.

Disappointed, he left for Geneva where he published his first literary work: *Lettres d'un habitant de Genève à ses contemporains* (1803). He had been drinking deeply of the cup of life and now confessed at the age of forty-three: "I am no longer young, I have observed and reflected." These are the opening words of the book. Impetuously and rashly he sent a copy to Bonaparte; he far from flattered the Emperor who was able to read on page eighteen: "No more honors for the Alexanders; long live the Archimedes'."[5] This effected a breach of ill-feeling between the dreamer and the warrior, which was never healed. The outstanding newness of this monograph is that it states: "All men will work; they will look upon each other as workmen attached to a workshop. . . . The obligation is imposed upon each one to give constantly to his personal forces a direction useful to humanity."[6] This comparison of society to an immense workshop is strikingly novel. Saint-Simon developed this theme more extensively in his *Système Industriel* (1821), the *leitmotif* of which is that labor is the highest duty of citizens and that workers, not idlers, are to run society. This idea has made it possible for subsequent commentators on Saint-Simon to consider him as the forerunner of our modern labor and trade unions.

After leaving Geneva, he took a rapid trip through England and Germany, storing away abundant material to comment on and write about.

[4] Maxime Leroy, *La Vie du comte de Saint-Simon* (1925), 213.

[5] Felix Alcan edition (1925).

[6] *Idem*, 61.

By this time he had used up all of his money and went through a period of poverty. In his hour of dire distress he appealed for financial help to his former associate Redern, whose fortune he had helped make, but who now turned a deaf ear. For the time being he was saved by a small family pension.

From this moment on, despite the harrying exigencies of his daily existence, he devoted all his time with serene certitude to the writing of treatises on the whole gamut of human enterprises: industry, government, religion, education, justice and labor, in which he proposed reforms for the entire fabric of society. His literary creations reveal a mind intensely interested in alleviating existing ills and evils, and a spirit that had determined to focus a strong light on the many injustices done to man by man.

Saint-Simon's mental genius was at its height when in 1812 he met the young historian Augustin Thierry, who called himself his "pupil" and "adopted son." A solid friendship developed between them, and in 1814, after the Napoleonic Wars, both men agreed that the origin of the chaotic misfortunes of France and Europe was war. They seized upon this dark moment to collaborate in the writing of the prophetic book: *De la Réorganisation de la Société Européenne ou de la nécessité et des moyens de rassembler les peuples de l'Europe en un seul corps politique en conservant à chacun son indépendance nationale.*[7] This work, with its trenchant and revealing comments, embodies Saint-Simon's far-reaching ideas on a league of nations and forms the basis of the remaining discussion.

II

In presenting a series of related points of view with regard to a league of nations, we must bear in mind that Saint-Simon was groping—just as Wilson was in 1919, and as Roosevelt and Churchill are today—for the formula to ensure a lasting and dignified global peace. At the very outset of his book, which transcends the narrow circle of immediate problems, Saint-Simon posed the following pointed questions, which might well have been propounded today: "Europe is in a violent state, everybody knows it and says so; but what is this state? Where does it come from? Has it always been? Is it possible for this state to end? These questions are still unanswered."

Saint-Simon very seriously attempted a reply. The problems with which he grappled, and with which we are still grappling, are the same: the outlawing of war, the improvement of the moral and physical well-being of the poorest class, fair and humane conditions of labor, a league of nations invested with the power to judge disputes, economic and industrial rivalry,

[7] The title page bears the following: "par M. le Comte de Saint-Simon et par A. Thierry, son élève" (Octobre 1814). This book is written in the first person singular; therefore, just how much Thierry contributed is problematical.

territorial aggrandizement, international policing, self-determination of all nations large or small, respect for minorities, the abolition of racial and religious discriminations. They are still the same problems plaguing mankind and gnawing at the vitals of a crumbling civilization. Saint-Simon's solutions are very much in line with those that Wilson effected at the end of World War I, and are similar to the ones we are striving for so earnestly in the present global holocaust.

Half-heartedly and sporadically, lip service is paid to the supposed ideal and humane relations between peoples of different races, creeds and colors. Then we bow in passive acquiescence to the traditional prejudices nurtured in our midst. Brotherhood and freedom in fellowship are but diplomatic fiction. Social and religious differentiation in formative years helps to create and maintain the barriers against instinctive democratic procedure. Saint-Simon had pondered long over these defects in organized society; therefore to appreciate his proposals, which were not a mere juggling of grey and dusty abstractions, we must trace them to the idealistic principles on which he built his foundation of society: "Men must act as brothers to one another. . . . If all institutions were directed toward the aim of the amelioration of the moral and physical well-being of the poorest class, they would make all classes of society and all nations prosper with the greatest rapidity possible."[8] Wilson, just as cognizant of the harsh and irritating discriminations which still prevailed and which rendered our boast of equal rights for all a mockery, was moved by the same impulses as Saint-Simon.[9] It was evident to Saint-Simon that one had to build from the bottom up, so as to fashion a design to better mankind, and obviously the first step to be taken, if there was sincerity in the desire to reach the permanent summits of peace, was in the direction of the alleviation of the impoverishment of the global downtrodden. Article XXIII of the Covenant of the League of Nations and point five of the Atlantic Charter took this very matter into consideration. Our modern conceptions have not evolved very far from the prescient theories of the Frenchman.

The latter, realizing that "particular confederations and coalitions opposed in interests will cast Europe back into that sad state of war from which one has in vain tried to extricate it," insisted on the far-sighted idea that "all nations of Europe be governed by a national parliament, and con-

[8] *Nouveau Christianisme* (1825); Éditions Baudinière, avant-propos par Olinde Rodrigues, 10 and 14. This treatise, published the year of Saint-Simon's death, embodied the precepts of a New Christianity, and along with other doctrines of Saint-Simon became the watchword of the entire school of Saint-Simonians, as they styled themselves. Among them we find the following disciples: Auguste Comte, Bazard, Enfantin, Henri Fournel, Pierre Leroux, Félicien, David, Dubochet, Stéphane Morey, Olinde Rodrigues, Léon Halévy, Bailly (de Blois) and Duvergier.

[9] Woodrow Wilson, *War and Peace*, I, 51, 480, 398.

cur in the formation of a general (continental) parliament, which will decide the common interests of Europe."[10] Thus Saint-Simon was projecting our contemporary conception of a league of nations: "Europe would have the best organization possible, if all the nations that it holds, each being governed by a parliament, would recognize the supremacy of a continental parliament placed over all the national governments and invested with the power of judging their disputes."[11] The Frenchman, who had touched the universal chord with a deft finger, had developed his thematic credo that global association should suppress war.[12]

Displaying a lively awareness that a structure like a league of nations would take too long to build in Europe in 1814, Saint-Simon drew up a form of positive procedure, which as a *point de départ* would refer directly to England and France, since they were at the time the most powerful nations in Europe. In his plan, England and France would be the basic props for a foundation of a league of nations to outlaw war. First, he attacked the evil of economic rivalry by warning that "if France and England continue to be rivals, the greatest of misfortunes will result both for them and for Europe from this rivalry; if they unite their interests . . . they will be tranquil and happy, and Europe will be able to hope for peace."[13] To avoid further bloodshed he advocated that England and France join and combine to rule Europe for the public good. His proposals were concrete: "Alliance of their navies to expand commerce, increase industry and facilitate wider navigation . . . to have but one paper money so as to render circulation more active; a bank common to both nations established by a European and Anglo-French parliament. . . ."[14] Wilson took practically the same stand.[15]

[10] *De la Réorganisation,* etc. (1814), p. 196 of the edition *Oeuvres de Saint-Simon et d'Enfantin,* 1–2 (Paris, 1868).

[11] *Idem,* 197.

[12] W. Wilson, in *War and Peace,* 525, and Article XII of the Covenant follow very much in the vein of Saint-Simon.

[13] *De la Réorganisation,* etc., foreword, *et sq.*

[14] *Idem,* 235.

[15] *Op. cit.,* 257 and 637. With regard to economic rivalries compare two recent opinions that are *à propos,* in as much as they are related to Saint-Simon's theories. There is much truth in the statements by Secretary Hull and Justice Frankfurter appearing a short time ago, even though there is a difference in their stress on the economic question, which is one of inextricable complexity. Secretary Hull alleged that the path to enduring world peace was through economic freedom and through "agreed action . . . directed to the expansion, by appropriate international and domestic measures, of production, employment and the exchange and consumption of goods which are the material foundations of the liberty and welfare of all peoples." (*New York Times,* May 27, 1942; 4: 7.) Justice Frankfurter recently expressed his philosophic opinion on this matter in an inaugural address: "The

As if foreseeing what would occur in 1942, Saint-Simon in collaboration with his "pupil" Thierry, in a brochure of fourteen pages entitled: *Opinion sur les mesures à prendre contre la coalition de 1815,* defended the idea that a State, unless authorized by a plebiscite, must not seek territorial aggrandizement.

Although Saint-Simon was an intellectual apostle of peace, he was very conscious of the fact that the whole social structure could not be erected on the fragile virtue of agreements, and that what was necessary was "a coactive force (international police) to carry out common interests and solid pledges."[16] He was extremely farsighted in this thought, for in World War I there was some policing, whereas at the end of World War II there will be a great deal of international policing to keep the equilibrium between good will and lasting peace, and to make our charters and manifestos more than the mere expressions of aspirations.

From Saint-Simon's proposals—issues which probe the very supports of organized society—and from his insistence on international relations, it is evident that he believed that our world ills were derived from a self-destructive, sterile isolationism. It is indubitably true that peoples and nations have been too absorbed in the pursuit of vainglorious and selfish aims and have lost sight of the broader problems of life. Since among the nations of the world there can be no isolationism—unless we desire an effete state—a universal civilization will have to transcend national interests. Harmonious international relations can only be achieved by knowing what is going on in other countries. Therefore, Saint-Simon suggests that questions of science, art, legislation, commerce, education, administration and industry be brought before the league and that "every question of mutual interest to the league be set before the continental parliament, and examined by it."[17]

To maintain the vitality of democratic and humane aspirations, the thorny question of the self-determination of nations, small or large, must be placed in the foreground and highly respected, for each race has characteristics and gifts which it contributes to the general fund of civilization and

world has the resources and the techniques; if we could only create the organizations to use them, capable of reducing to a position of secondary importance the economic problems which now absorb our moral and material energies. Economics is not the whole of life. Very far from it. But on the fair and sensible control of economic forces depends the opportunity to pursue civilized life. . . . If we can only bring sufficient good will and resolute purpose to bear, the day need not be far off when the economic problem will take a back seat where it belongs and the arena of the heart and head will be occupied by our real problems—the problems of life and human relations, of creation and behavior and religion." (*New York Times,* Oct. 1, 1942; 25: 1.)

[16] *De la Réorganisation,* etc. Edition of Les presses françaises, XVI.

[17] *Oeuvres complètes,* v. 1–2, 203.

from which all nations can profit. Saint-Simon was just as advanced as Wilson, Churchill and Roosevelt[18] in his ideas on self-determination when he wrote that "if some part of the European population, subject to some government, should want to form a nation apart or enter under the jurisdiction of a foreign government, it will be up to the central parliament to decide on this. Now, it will not decide in the interests of governments, but in the interest of the people, while having as its aim the best organization possible of the European confederation."[19]

To end harsh racial and religious discriminations and to bear in mind the basic oneness of the universe and to arrive at a sincere and unadulterated spiritual freedom, Saint-Simon advised that "the continental parliament shall permit entire liberty of conscience and the free pursuit of all religions. . . ."[20] The Frenchman found a prolonged echo in Wilson who called attention to the dream of The League of Nations' recognizing "the inalienable rights of nationality; the rights of minorities and the sanctity of religious belief and practice."[21]

In addition to the idealistic schemes that kept bubbling in his mind Saint-Simon proposed some realistic methods which might serve as a basis for keeping and assuring peace: "The parliament will join the Danube to the Rhine and the Rhine to the Baltic by canals . . . will occupy the people with great internal projects . . . will render it possible to travel and live everywhere in Europe . . . will provide public instruction all over Europe."[22] Conventions relating to the Freedom of Transit and Ports, Waterways and Railways were prepared at the end of World War I, and there is no doubt that much more will be effected in these fields of endeavor to repair the damage done in World War II, in addition to an all-embracing blueprint of world economic relationships, which will no longer degrade weaker countries to the inferior position of a colonial economy.

Saint-Simon's idea of providing public instruction has been carried farthest here in the United States, the country for which he fought. But although great progress has been made in the fields of instruction and education, there is still much to be desired. Our education is still limited by the cash nexus, and permits prejudices to be instilled at an early age. It has failed to do away with racial discriminations, educational quotas, the poll tax, the philistine crassness of "Jim Crowism," grotesque distortions of politics and economics, and religious as well as cynical hypocrisy.

[18] See Wilson, *War and Peace,* I, XXXIV; Article X of the Covenant; Third Point of the Atlantic Charter.

[19] *Oeuvres complètes,* 203.

[20] *Idem,* 205.

[21] *Op. cit.,* 524.

[22] *Oeuvres complètes,* 204.

However, Saint-Simon did not believe that he was battering himself in vain against the obduracy of a world both evil and mad. On the contrary, while dreaming of the establishment of a political system consonant with a state of enlightenment and of the creation of a general power invested with the force capable of curbing the ambitions of governments, he turned his ear to the future and heard the hum of universal change swell to a roar. He ended his book on *The Reorganization of Society* in a prophetic vein that could not be more timely: "The time will come undoubtedly, when all the peoples of Europe will feel that points of general interest must be regulated before arriving at national interests; then misfortunes will begin to be less, disputes will be allayed, wars will be done away with; this is what we are aiming at and this is where the human mind is conveying us!. . . . The golden age of mankind is not behind us, it is before us, it is in the perfection of the social order; our parents did not see it, our children will reach it some day; it is up to us to mark out the road for them."[23]

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[23] *Idem*, 247 *sq.*

BOOK REVIEW

Physics and Philosophy. By Sir James Jeans. Cambridge: At the University Press; New York: The Macmillan Co., 1943. Pp. 222. $2.75.

Thales of Miletus, astronomer and philosopher, was an authority on solar eclipses, and asserted that all things were watery and "full of gods." Sir James Jeans, twenty-five hundred years later, is engaged in a similar dual rôle, enjoying, however, the rich resources of the history of physical science and philosophy from which to compose "The reflections of a physicist on some of the problems of philosophy." This should be the sub-title of the book, he tells us in his preface, which announces also that recent developments of theoretical physics make it "interesting and important" to explore questions "far beyond the technical problems of physics and philosophy which touch human life very closely, such as materialism and free-will. Thus I hope the book may interest many who are neither physicists nor philosophers by profession." Finally, the brief but illuminating preface reveals that the author's "acquaintance with philosophy is simply that of an intruder," and that he has received valuable criticisms and suggestions from Sir Arthur Eddington and Professor J. B. S. Haldane. It is well known that in their philosophic views these two eminent British scientists espouse subjective idealism and dialectical materialism respectively.

In his earlier popularizations of astronomy and physics (*The Universe Around Us, The Mysterious Universe, The Stars in Their Courses*), Jeans followed admirably and with a deserved best-seller's success the excellent tradition of British scientists who have brilliantly diffused their knowledge and the spirit of their explorations to a wide public without violating the high standards of clarity and accuracy which are the pride and glory of all men of science. The names of Boyle, Gilbert, Herschel, Faraday, Tyndall, Huxley, Clifford, Russell, and others stand for a splendid achievement in the *haute vulgarisation* of physical science in Great Britain. Yet distinguished scientists in thus serving the public have left themselves open to serious criticisms when they extend their published forays into questions beyond their special field of competence, so that we now have a right to expect some cognizance of these criticisms of their extra-scientific speculations. Such cognizance is unfortunately lacking in Jeans's invasion of epistemology and the history of physics and philosophy, which he surveys within the compass of a small volume. It is a fallacy of composition (in both the logical and literary senses) to think that a book is more interesting if it touches on a great many interesting questions, especially when scant space or consideration is given to each and when the questions border on those of technical physics and philosophy. If the result is confusing to the physicist and philosopher, the book can hardly be expected to clarify the mind of the lay reader.

So long as the history of scientific ideas and of their social and philosophical matrix have not been systematically and critically studied by their popularizers, such attempts as this one of Jeans are bound to grow wild in the uncultivated borderlands lying between a special science and other disciplines. The scientific specialist when he wishes to deal with the humanistic aspects and ramifications of his science should be ready to assume the extra burden of historical, philological, and philosophical researches required. Perhaps those who do conduct these researches have neglected the ideas vital to the history of science, so that the public will get its notions about the progress and broad implications of science from scientists of reputation disporting themselves on a philosophic holiday. In any case, Jeans's book shows that the history of scientific ideas in their wider reaches cannot be left simply to experts who have manipulated these ideas successfully within their own specialty. We look in vain for the continuity of recent developments in physics with the cumulative achievements of previous scientific thought or with the main streams of philosophic inquiry into the foundations of physical science. To substantiate these rather strong reactions to Jeans's latest book, the reviewer submits the following selected items.

1. "A direct questioning of nature by experiment has shown the philosophical background hitherto assumed by physics to have been faulty" (2). Surely the history of physics and philosophy shows more than one such background. Even if we confine ourselves to the seventeenth century, every beginning student knows of the controversies between Ptolemaists and Copernicans over "saving the appearances," between Galileo and the Aristotelians who would not look through his telescope, between Newton and Leibniz over space and time and God, between Boyle and Spinoza over the limits of experimental knowledge, between Descartes and Leibniz over *vis viva* and the essence of matter. No mention is made by Jeans of the Cambridge neoplatonism in Newton's philosophic background, nor why the French materialists found Newton more congenial to their philosophy than the Cartesian physics which was for some time more popular in England than in France. Again, the positivistic philosophy of science is treated by Jeans as represented solely by Comte, to the complete neglect of the much more important physical theories of Mach and Duhem who had different philosophical backgrounds and very different interpretations of the history of science, differing from one another as well as from Comte.

2. After quoting Huyghens, who wrote in 1690: "In true philosophy, the causes of all natural phenomena are conceived in mechanical terms. We must do this, in my opinion, or give up all hope of ever understanding anything in physics," Jeans adds: "Today the average man probably holds very similar opinions" (13). Surely the "average man" has but the roughest comprehension of what Huyghens or his contemporaries understood by a mechanical explanation, if we recall that to them it meant explanation

in geometric terms of transmission of motion by contact and of central forces. The electro-magnetic theories of Maxwell and Faraday clung with difficulty to this type of explanation, but the difficulty is not made clear by Jeans (120 ff.). Does Jeans think he can really convince "the average man" why all mechanical explanation "has failed and must fail" if the grounds for its alleged complete failure are provided by the technical considerations of relativity and quanta theory? The fact is that apart from the special phenomena covered by these technical theories, the classical Newtonian mechanics is still valid for most of the phenomena ordinarily encountered where velocities do not approach that of light. It is extremely doubtful that all physicists or philosophers, let alone the "average man," will find at all convincing Jeans's arguments that the new physics of large-scale and small-scale phenomena imply a mentalistic view of space, time, and "ultimate reality." While it is true that the "common-sense" of "the average man" does reflect the uncriticized repository of ancient metaphysical and scientific theories embedded in language, it is important to show the conflicting diversity of these theories and the need for critical clarification of them when employed in explanations. No jury would excuse a heinous crime deliberately committed, on the ground alleged by Jeans that the "average man" believes in prerelativity mechanistic determinism and hence that criminals cannot act of their own free-will. Nor did "mechanistic philosophers" who accepted mechanical explanations *in physics* (as 'non-teleological'), find it necessary to accept the same sort of explanation for human actions. This is amply evident in Descartes, Newton, Kant, and even in Hobbes whose political sagacity rests on his psychological insights rather than on his professed mechanistic materialism.

3. Jeans never intimates that the fact that physicists today still find Newtonian mechanics adequate to deal with many "man-sized facts," is evidence that there is a fundamental continuity in the history of their science. Hence it is sheer unwarranted mystification for Jeans to talk about the complete failure of classical physics in the way dialectical materialists and other theologically-minded critics of science do in their discussions of the "failure and crisis of contemporary culture." When a fundamental change occurs in the theoretical framework of a science it is not because of some external social revolution or spiritual or epistemological crisis, but because certain experimental findings are not logically explained by the prevailing theories within the science itself. No school of philosophy has ever been able to undermine the cumulative logical continuity of science.

4. Many points in the history of philosophy are grossly misstated; the following are only samples: (a) Thales, Epicurus, Heraclitus, and Bruno are cited as great names in science as well as in philosophy (17, 20); (b) Hegel is reported as regarding the "workshop of the philosopher" to be "his own brain" (17); (c) Plato, we are repeatedly told, presented the

Ideas as ultimate realities residing only "in our minds" (33 ff.); (d) the "rationalists" are all assigned to the Continent (38) and held to maintain that the highest truths reside in our own minds, whereas the "empiricists" are all consigned to Great Britain and made to affirm that truth lies outside our minds (34). Poor Kant suffers most of all in Jeans's handling of "certain threads which run clearly through the history of philosophy" (17), when we are told that Kant claimed that it ought to be possible "to construct 'a pure science of nature,' which should be independent of all experience of the world," and "attempted a reasoned discussion of this question in his famous *Critique of Pure Reason*" (35), a similar view being held, according to Jeans, by Plato and Eddington. Although Kant did seek a metaphysic of nature in his *Metaphysische Anfangsgründe der Naturwissenschaft* (published posthumously long after the *Critique* and differing essentially from it as well as from Kant's precritical or Leibnizian philosophy of science), everybody knows that the whole aim of Kant's *Critique* was to show the impossibility of any scientific knowledge of objects beyond possible experience, such as Plato's Ideas or Eddington's Mind or Jeans's "ultimate reality." Kant worked in vain when he thought he had proved by means of his antinomies the impossibility of determining the size of the material universe or its duration, for Jeans finds the hyphen inserted between space and time in recent physics has done away with all of Kant's arguments! There is no historical or logical justification for Jeans's inference that Roemer's measurement in 1676 of the speed of light and Bradley's discovery in 1725 of aberration "show that space and time are not totally independent of one another as Kant and many others seem to have imagined" (63), on the ground alleged by Jeans that Kant did not appear to know that light takes time to travel through space. Anybody knowing how close a student Kant was of the astronomical literature of his day (Newton, Maupertuis, Bradley, Euler), would scarcely suspect Kant of such ignorance, even though Adickes has shown in his two-volume work on *Kant als Naturforscher* (Berlin, 1924–5) that Kant was no more than a brilliant amateur when it came to matters of scientific detail.[1] In any case, a closer study of Kant on Jeans's part would have helped him avoid making amateurish errors concerning Kant. It is well known also that "space-time" could not come into scientific use until the work of Riemann and Minkowski, and that no relativity considerations have any bearing on many of Kant's epistemological questions about space and time unhyphenated.

[1] An exact and direct reference to the velocity of light in Kant was pointed out to me by my friend, Jerome Rosenthal, who shared my suspicions about Jeans's inaccuracies, and to whom I owe very much in matters of intellectual history. The reference is to be found in the first footnote to Kant's short essay, published in 1794, *Etwas über den Einfluss des Mondes auf die Witterung,* where Kant tells us it takes *about* 1 1/5 seconds for light to reach us from the moon. This accords with Roemer sufficiently to refute Jeans's statement (63) of Kant's ignorance of the fact.

In his criticisms of Eddington's misguided attempt to revive a priorism in physics after it has become discredited in philosophy (72), Jeans fails to make clear why a priori knowledge has become discredited in philosophy. A proper understanding of Kant would have helped here also.

5. A most flagrant type of confusion that occurs in Jeans's book is his account of the differences between science and philosophy both with regard to method and subject-matter. "The tools of science are observation and experiment; the tools of philosophy are discussion and contemplation" (81). This over-simplified contrast leaves us in the dark with regard to the rôle of logical discourse in science and of experience in philosophy. The "two voices of philosophy and science" cannot be, as Jeans claims, expressions of "facts as they are revealed by our primitive senses" *versus* facts "revealed by instruments of precision" (84), since theories and hypotheses play a large rôle in the formulation of both types of facts in science and philosophy. Nor is it correct to say that "the philosopher usually thinks in terms of qualities, the scientist in terms of quantities" (89). Here Jeans missed a chance to contribute to the historical epistemological controversy over primary and secondary qualities. He could have explained why Galileo, Descartes, and their contemporaries treated the geometric properties for which they had worked out methods of measurement as *primary* or inherent properties of bodies, whereas the remaining properties for which they had no ordering rules were relegated to the vaguer subjective world. Nowadays, as Jeans should know, mathematical science is not restricted to quantity. In these matters Jeans should have referred to the historical development of scientific logic from its classical subject-predicate form to the more general relational logic.

6. Jeans's treatment of Zeno's paradoxes leads him to reject the law of excluded middle as well as the "strait path of formal logic" (95). Dialectical materialism may be the source of Jeans's confusion here.[2] The same source may account also for his attempt to define causality in terms of "the whole previous state of the world" or "the state of the world at this instant," so that for him there is "no justification for dividing the happenings of the world into detached events" (103). What scientist or sane person has ever tried to find the cause of anything by considering the state of the whole world at an instant? And how does anybody proceed to solve a causal problem without detaching relevant from irrelevant events?

The more trustworthy portions of the book are to be found in the discussion of the contributions of Planck, Rutherford, Bohr, Heisenberg, De

[2] Jeans never alludes to the more important critics of the law of excluded middle, namely, Brouwer and his school of constructionists, who far from abandoning the "strait path of formal logic," insist on more formally rigorous foundations for mathematical proofs.

Broglie, Schrödinger, and Dirac to the new physics, where Jeans is more at home. The *evolution* of this new physics is everywhere subordinated by Jeans to its novel aspects, and in this regard, is treated much more clearly in the popular but accurate work of Einstein and Infeld, *The Evolution of Physics*. It can only confuse the layman when he is told by Jeans: "The theory of relativity deals with measures of things, and not with things themselves, and so can never tell us anything about the nature of the things with the measures of which it is concerned. In particular it can tell us nothing as to the nature of space and time" (68), and "the physical theory of relativity has now shown (134, 137) that electric and magnetic forces are not real at all; they are mere mental constructs of our own" (200). Are not mental constructs also "real"? But of course only those who follow Jeans's transcendental epistemology would call an electric shock a "mental construct."

The last chapter on the problem of free-will reveals the high but futile idealism of the author. He assumes that the progress of physics throws light on the ethical problem. "The old physics showed us a universe which looked more like a prison than a dwelling-place. The new physics shows us a universe which looks as though it might conceivably form a dwelling-place for free men, and not a mere shelter for brutes" (246). The ancient poets and philosophers had no need to resort to physical theories in order to know the bondage of the passions and of social injustice, and our war-torn world will not find the freedom it seeks in the new physics. In his popular survey of an important segment of the history of thought, Jeans has made a fundamental error in transferring the locus of the problem of human freedom from its social context to a dubious philosophy of physics.

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BOOKS RECEIVED

PLATO ARABUS EDIDIT RICHARDUS WALZER. VOL. II. ALFARABIUS DE PLATONIS PHILOSOPHIA EDIDERUNT F. ROSENTHAL ET R. WALZER. In Aedibus Institute Warburgiani Londinii MCMXLIII. London: The Warburg Institute, 1943. 18 shillings.—*Plato Arabus vol. I Galeni Compendium Timaei Platonis,* printed in Beirut, could not appear before *volumen II.* These are the first Arabic texts in the series *Corpus Platonicum Medii Aevi edidit Raymundus Klibansky.* In the Latin preface (pp. xxii) of vol. II, the editors discuss *Alfarabi's De Beatitudine* and *De Platonis philosophia,* De Alfarabii fonte graeco, De versione Syriaca, De Alfarabio epitomatore, De Codice manu scripto et de Falaguera epitome Hebraica, De ratione edendi, De Alfarabi libri inscriptione. Then follow the Latin version *De Platonis Philosophia* (pp. 16), *Notae* (17–28), Index Nominum and finally the Arabic text.

THE ARABS. A Short History. By Philip K. Hitti. Princeton: Princeton University Press, 1943. Pp. 224. $2.00.—Sketch of the cultural history of the Moslems (who number 275,000,000 today) since the Bedouin Arabs' conversion by Muhammad.

THE CHRISTIAN PHILOSOPHY OF HISTORY. By Shirley Jackson Case. Chicago: University of Chicago Press, 1943. Pp. 222. $2.00.—"God is discovered working within history, where he has willed that men should learn to be the efficient instruments of the divine energy. Upon their shoulders has been placed the responsibility for learning and pursuing God's designs for bringing this kingdom to realization on earth." Chapter II, The Providential View of History, discusses the Hebrew view, the early Christian view, God in world history, the Augustinian interpretation of history, and the survival of providential history (Gregory, Bossuet, and the neo-Thomists).

RELIGION AND EMPIRE. The Alliance between Piety and Commerce in English Expansion 1558–1625. By Louis B. Wright. Chapel Hill: The University of North Carolina Press, 1943. Pp. ix, 191. $2.00.—The sense of being part of a divine plan existed in Elizabethan England's concept of imperial destiny and was preached by patriotic clergymen like Hakluyt, Purchas, and ships' chaplains.

JOHN AMOS COMENIUS. That Incomparable Moravian. By Matthew Spinka. Chicago: University of Chicago Press, 1943. Pp. 177. $2.00.—The life of the seventeenth-century "father of modern pedagogical theory and practice," his ecumenical and scientific interests based on his "pansophic ideals" of religion, peace and the unification of knowledge.

FRENCH MERCANTILISM 1683–1700. By Charles Woolsey Cole. New York: Columbia University Press, 1943. Pp. xi, 354. $4.25.—Sequel to *Colbert and a Century of French Mercantilism.* Covers the period from the death of Colbert to the end of the seventeenth century.

LA TRADITION LITTÉRAIRE DES IDÉOLOGUES. Par Emile Cailliet. With an Introduction by Gilbert Chinard. Philadelphia: The American Philosophical Society, 1943. Pp. 322. $4.00.—"The Ideologues, often spoken of as the 'Fathers' of the French Revolution, were the bearers of the naturalist philosophy coming down from ancient Greece, a philosophy which shaped the course of the French and American Revolutions and, as the torch was passed on to Stendhal, Taine, and Zola, continued in large measure also to determine that of the nineteenth century."

EDWARD TYSON, M.D., F.R.S. 1650–1708 and the Rise of Human and Comparative Anatomy in England. A Study in the History of Science. By M. F. Ashley-Montagu. With a Foreword by George Sarton. Philadelphia: The American Philosophical Society, 1943. Pp. xxix, 488. $5.00.—Tyson's *Orang-Outang, sive Homo Sylvestris* (June 1699) supplied to the eighteenth century the data for the idea that the anthropoid ape was nearest to man in the Great Chain of Being.

THE PHILOSOPHY OF AMERICAN DEMOCRACY. Edited by Charner M. Perry. Chicago: University of Chicago Press, 1943. Pp. 153. $2.00.—Walgreen Lectures of 1941–42 series: "Thomas Paine: Voice of Democratic Revolution" and "Justice Holmes: Voice of Democratic Evolution," both by T. V. Smith; "The Rhetoric of the Debate over the Adoption of the Constitution," by C. H. Faust; "The Meaning of Freedom" and "The Ideal of Freedom," by Frank H. Knight.

THOMAS JEFFERSON. Papers read before the American Philosophical Society in celebration of the Bicentennial of Thomas Jefferson, Third President of the Society, April 22–24, 1943 Proceedings, vol. 87, no. 3, pp. 199–289. Philadelphia: The American Philosophical Society, 1943. $1.00.—A symposium on Jefferson's interests in political philosophy (Carl Becker, John Dickinson), law (Roland S. Morris), agriculture (M. L. Wilson), classics (Louis B. Wright), science (Harlow Shapley), fine arts (Fiske Kimball), and the American Philosophical Society (Gilbert Chinard, Carl Van Doren), with an introduction by President Edwin G. Conklin.

THOMAS JEFFERSON. Selections from His Writings. Edited with an Introduction by Philip S. Foner. New York: International Publishers, 1943. Pp. 97. $.85.

WILLIAM SMITH: EDUCATOR AND CHURCHMAN 1727–1803. By Albert F. Gegenheimer. Philadelphia: University of Pennsylvania Press, 1943. Pp.

233. $2.50.—Seventh of the Pennsylvania Lives series. The loyalist Episcopalian clergyman was author of *College in Mirania* (1753) for the teaching of science and religion in New York. He was the first provost of what came to be the University of Pennsylvania, and also founder of the college of Washington in Maryland.

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ANALYTICAL INDEX TO VOLUME IV

Acrasia, Spenser and the Renaissance Circe, 381–399
American, history, 217–223; literature, Kazin on, 368–373; religion (*q.v.*)
Ancients and moderns, 63 f., 220, 436 ff.
Anthropology, in early Greek science, 162, 165; of Spenser, 382
Anti-historicism, 429 f.
Antinomianism, 268–279, 307
Arminianism, 260 ff., 279 f., 286
Aristotelianism, in Patrizi, 224 ff.; of Spenser, 390 f.; in medieval physics, 408 f.
Art, of Renaissance, 43 ff.; early Greek science and, 166; theories of 17th- and 18th-century rationalists, 436 f.
Astronomy, authentic title of Copernicus's major work, 457–474; in Renaissance, 8 f., 53
Atomism, in early Greek science, 169 f.

Cartography, in Renaissance, 3 f.
Catholicism, 189, 347; in England, 316 f.; v. Scholasticism
Causation, in recent studies of English Revolution, 349–367
Chain of being, in Renaissance, 391 f.
Chartism, Mill on, 137, 138, 141
Christian, literature, 193–216, 301 f.; case against Voltaire, 193–216; sensibility, 301–319; thinking illustrated in Calvin's *Institutes*, 287–300
Classical, humanism in Renaissance (*q.v.*)
Continuity and originality in Renaissance (*q.v.*)
Cosmogony, and early Greek science, 162 f.
Cosmopolitanism, Greco-Roman, 105–111
Criticism, and fiction, 368–373
Cumulative, conception of history, 431 f., 455 f.

Deism, 307, 309, 315, 318
Democracy, and liberalism in Mill, 127–160
Diggers, 355, 360 ff.

Economic, classical doctrine, 127–160; determinism in English revolution, 349–367; ideas of Swift, 75 f.; of Mill, 127–160
Eighteenth century, anti-historicism, 429 f.; Hume: Sceptic and Tory? 332–348; primitivism, 118; self-love and doctrine of work, 320–332
Empiricism, in historiography, 429 f.
English, case against Voltaire, 193–216; democratic liberalism of Mill, 427–460; economics, 75 f.; literature and science in Renaissance (*q.v.*); revolution and historical causation, 349–367
Enthusiasm, and mysticism in religion, 301–319

Fifteenth century, Italy (*q.v.*); Renaissance (*q.v.*); science (*q.v.*)
Form, philosophic discovery of, 177–192
Fourteenth century, and Renaissance (*q.v.*), 6 f.; and history of science (*q.v.*)
Freedom, Mill on, 152 f.

French, and liberalism, 127; utopian socialists, 147, 149, 152, 159, 475–483

Greek, and Roman nationalism and cosmopolitanism, 105–111; early science, problems and methods, 161–176; Platonism (*q.v.*)

Historical, causation in English revolution, 349–367
History, attitudes of modern rationalists to, 429–456; changing form, 217–223
Humanism, and science in Renaissance (*q.v.*)

Individualism, in Mill, 152 f.
Italy, tradition and innovation in 15th cent., 1–74

Laissez faire, Mill on, 143 ff.
League of Nations, Saint-Simon, utopian precursor of, 475–483
Levellers, 355, 359–361
Liberalism, Mill as pioneer of English democratic, 127–160

Marxism, in historiography, 349–367
Mathematics, in early Greek science (*q.v.*); in scholastics (*q.v.*) in Renaissance (*q.v.*)
Mercantilism, Swift on, 77 f.
Method, of historiography, 1–70, 429–456; of physics, 400–428
Microcosm, 391 f.
Middle Ages, 188, 220, 307
"Modern Age," a new, 63 f.
Mysticism, and enthusiasm in Christianity, 301–319; mathematical (*q.v.*)

Nationalism, Greco-Roman, 105–111
Nature, meaning in Renaissance, 53 f., 72 f.
Neoplatonism, in middle ages (*q.v.*); in Renaissance, 451 ff.; of Spenser's *Faerie Queene*, 390 f.
New England, "preparation for salvation" in 17th century, 253–286
Nineteenth century, methodology of historiography in, 452
Noble savage, of Madagascar in 1640, 112–118

Organic, conception of history, 452 ff.
Originality, and continuity in Renaissance (*q.v.*)

Paradoxology, in early Greek science, 164
Philosophy, Greek (*q.v.*); and science (*q.v.*)
Physics, in Renaissance (*q.v.*); in Scholastics (*q.v.*); of Galileo and Plato, 400–428; and philosophy, 484–489
Pietism, 301–316
Platonism, of Galileo, 400–428; in discovery of form (*q.v.*); and nationalism, 107; v. Renaissance
Political, arithmetic, Swift on, 95 f.; ideas of Hume, 333–348; ideas of Mill, 127–160; history and medieval and Renaissance Italy, 22 ff.; thought and early Greek science, 166
Preformationism, in rationalists, 443 ff.
Prenaissance, Lynn Thorndike on, 65–74
"Preparation for salvation," in 17th-century New England, 253–286
Primitivism, Golden Age, 145; Noble Savage of Madagascar in 1640, 112–118; v. Theriophily

Progress, rationalistic ideas of, 443 ff.
Protestantism, doctrine of work and self-love, 320–332

Quattrocento, v. Fifteenth century

Rationalism, attitudes to history, 429–456; v. Form
Religion, Calvin's *Institutes*, 287–300; mysticism and enthusiasm (*q.v.*); "preparation for salvation" in New England (*q.v.*); Protestant doctrine of work (*q.v.*)
Renaissance, continuity and originality in, 1–70; science (*q.v.*); Spenser's Acrasia and Circe of the, 381–399
Roman, nationalism and cosmopolitanism (*q.v.*)

Salvation, preparation for, in New England (*q.v.*)
Scholasticism, and Renaissance, 1–70; and form, 188 ff.; in Spenser, 390, 395; in physics, 405 f.
Science, in 15th century Italy, 1–70; physics and philosophy, Jeans on, 484–489; problems and methods of early Greek, 161–176; medieval and Renaissance, 400–428
Seventeenth century, Calvinism, 287–300; mysticism and enthusiasm, 301–319; Noble Savage of Madagascar in 1640, 112–118; "Preparation for Salvation" in New England, 253–286; problem of causation in recent studies of English revolution, 349–361; rationalists' attitudes to history, 429–466; view of human nature, 392
Sixteenth century, science and humanism, 1–70; English literary Renaissance in, 381 f.
Socialism, of Mill, 147 f.
Space, Patrizi on, 224–245

Teleology, in historiography of rationalists, 445 ff.
Theriophily, and Spenser, 382 f.
Tradition, and innovation in 15th-century Italy, 1–20

Utilitarianism, of Mill, 127 f.

Work, self-love and Protestant doctrine, 320–332

NAME INDEX

(NAMES OF CONTRIBUTORS APPEAR IN SMALL CAPITALS)

Abelard, 53, 189
Abbadie, Jacques, 321 n.
Abbey, C. J., 322
Adams, Francis C., 266, 274 f.
Adelard of Bath, 16
Aeschylus, 107
Albert of Saxony, 69, 72, 189
Alberti, L. B., 9, 43
Alcmaeon, 161–176
Alexander of Aphrodisias, 20
Alexander the Great, 107, 109
Alexander V, Pope, 67
Alford, Henry, 324
Allan, D. J., 180
Almagia, Robert, 3
American Philosophical Society, 247, 491
Amerpool, J., 442
Ames, William, 257, 259, 262
Anaxagoras, 167 ff.
Anaximander, 161–175, 191
Anaximenes, 165–175
Anderson, Sherwood, 370 f.
Anselm, 188, 293
Antiphon, 106 ff.
Apelt, Ernst, 472
Aquinas, 184, 189, 382, 395, 407
Archimedes, 9, 18, 41, 401 f.
Archytas, 240
Argyropulos, J., 20
Ariosto, 397
Aristotle, 7, 12, 20, 35, 50, 61, 68, 73, 107 f., 167 f., 177–191, 224–245, 318, 369, 390 f., 401 f., 440 f., 469
Armitage, A., 473
Arnauld, 438 f.
Ascham, Roger, 387
Ashley-Montagu, M. F., 491
Augustine, 51 f., 111, 187 f., 293, 302 f., 395
Aurelius, Marcus, 111

Bacon, Francis, 7, 21, 24, 51, 57, 70, 80, 197, 318, 392 f., 401 n.
Baker, A. E., 320
Ball, John, 90, 257, 258
Barbon, Nicholas, 327
BARON, HANS, 3, 15, 21–48, 50, 56 ff.
Baron, Salo W., 251
Barrow, Isaac, 326
Barruel, 193–215
Battenhouse, Roy W., 250
Baur, Ludwig, 15
Baxter, Richard, 325
Bayle, Pierre, 194
Beard, Charles, 248, 369
Beardsley, Monroe C., 250
Beckford, William, 313
Beckman, 473
Belon, Pierre, 68
Benedetti, 19, 401, 415 f.
Bentham, Jeremy, 128, 129, 139, 160
Berengar of Tours, 73
Berenson, B., 389
Bernard, Claude, 190
Bernays, J., 108
Berry, Arthur, 472
Berti, D., 11
Birkenmajer, L. A., 13, 461 f.
Bissel, B., 112
Blaine, J. G., 222
Blane, Louis, 132
Blasius of Parma, 16
Bloomfield, L., 50
Blount, T. P., 351
Boas, George, 112, 382 f.
Boethius, 187
Boisguillebert, 327
Bolingbroke, Lord, 194
Bonaventura, 52
Bond, John, 113, 114
Bodin, Jean, 394 f.
Boileau, 436
Boothby, Richard, 114
Boswell, 333, 334
Boucher, Jonathan, 193–198, 317, 318
Bourne, Nicholas, 114
Bourne, Randolph, 369
Bowdler, John, 212
Boyer, Carl B., 14
Boyle, Robert, 58, 484 f.
Boylsen, 369
Brachvogel, E., 473
Bradstreet, Anne, 304
Bradwardine, Thomas, 15, 16, 57
Brahe, Tycho, 12, 473
Brandes, George, 91
Brathwaite, Richard, 323
Bredvold, L., 95, 98
Brewster, John, 215
BRICKMAN, BENJAMIN, 224–245
Briggs, 58
Brinton, Crane, 354 ff.
Broad, C. D., 320
Broscius, John, 465
Brouwer, 488
Browne, John, 90, 92, 96, 97
Browne, Sir Thomas, 307, 324
Browne, William, 382 f.
Brożek, Jan, 465
Brunelleschi, 43
Bruno, Giordano, 8, 12, 35, 36, 39, 224, 387 f., 462, 486
Brunschvicg, L., 425
Bulkeley, Peter, 263 f., 268, 270, 278
Bullitt, William M., 459
Buonamici, F., 420
Burckhardt, J., 1, 23, 28, 47, 48, 49, 53, 54, 60, 69, 70
Buridan, John, 11, 17, 72, 401 f.
Burke, Edmund, 194, 200, 205, 209, 210
Burnet, John, 177
Burney, Fanny, 201
Burrow, Frigant, 250
Burt, Alfred Le Roy, 247
Burtt, E. A., 14, 423 f.
Butler, Bishop, 320 f., 327, 329, 332
Byron, Lord, 369

Cabanis, 477
Cabell, James Branch, 370
Caesar, Julius, 68, 110, 111
Cailliet, Emile, 491
Calcagnini, 11
Caldwell, Erskine, 370
Calhoun, John, 220
Caligula, 340
Calvin, 112, 213, 253–286, 287–300, 317, 323, 332, 358, 363
Campanella, 224 f.
Campanus of Novarra, 16
Cantor, Moritz, 472
Cardan, 19
Cargill, Oscar, 368
Carlyle, Thomas, 115 f., 130, 155
Cartwright, Thomas, 362
Case, Shirley, J., 490
Caspar, Max, 460
CASSIRER, ERNST, 8, 14, 29, 33, 35, 41, 46, 48, 49, 250, 323, 403
Castiglione, 323
Cavalieri, B., 424
Caverni, R., 6, 405
Chauncy, Charles, 301, 315–316
Chetwode, 90
Childs, Sir Josiah, 80, 85, 96, 101
Chinard, Gilbert, 112, 491
Christ, 196, 208, 253–286, 295, 298, 308, 363

Christin, M., 202
Christmann, J., 474
Christophanes, 107
Chroust, Anton H., 495
Chrysippus, 109
Church, R. W., 335
Churchill, Winston, 475 f.
Cicero, 24, 29, 68, 109, 110, 111, 193
Circe, 381–99
Claggett, Marshall, 14, 16
Clarkson, Thomas, 317
Clifford, Charles, 207, 208, 210
Clowes, John, 209
Cobbett, William, 206
Cole, Charles W., 49
Coleridge, 317
Collins, Anthony, 325
Collins, James, 251
Collins, Joseph, 301, 304
Commandino, F., 19, 41
Comte, Auguste, 132, 477
Condorcet, 136
Conti, Natale, 396 f.
Coomaraswamy, A. K., 493
Copernicus, 8 ff., 57, 442, 457–474
Corneille, 437
Cornford, 178 f.
Cornwell, F., 269
Coss, John Jacob, 127
Cotton, John, 253 ff., 271 ff.
Courteen, Sir William, 113
Craig, William, 195
Crane, Hart, 372
Crashow, Richard, 307
Cremonini, 402
Cromwell, 340, 345, 357
Crosby, Fanny, 65
Crowl, Philip A., 496
Curtze, M., 13, 457, 473 f.
Cuvier, 477

d'Abano, Pietro, 7
d'Alembert, 207, 213, 475
da Feltre, Vittorino, 71
da Vinci, Leonardo, 1, 12, 19, 40, 44 f., 51, 69 f., 382, 401
d'Angelo, Jacopo, 20
Dante, 70
Daumier, 93
Davenant, Charles, 80, 83, 84, 96
DAVIS, JOE LEE, 301–319
de'Beldomandi, 16
de Cabarrus, Count, 476
de Faugères, Baron, 437
della Porta, Giovanni, 393, 394
de la Court, Pieter, 327
de Sponde, Jean, 395
Defoe, Daniel, 79, 80, 84, 89
Deichgraber, M., 176
Dembleton, 15
Demetrius, 108
Democritus, 178, 191, 245
Descartes, 7, 14, 169, 400 f., 430 f., 488
Dewey, John, 369
de Tocqueville, 132, 133
Diels, Hermann, 162 ff.
Digges, Thomas, 57
Dilthey, W., 36
Diogenes Laertius, 108, 110, 61
Diophantus, 434
Disraeli, Benjamin, 155
Dobbie, Elliott Van Kirk, 246
Dobbs, Arthur, 98, 93, 94
Donne, John, 324
Donner, George, 460 f.
Doppelmayr, J. G., 470 f.
Dos Passos, 370
Dossi, Dosso, 398
Dreiser, Theodore, 369
Dreyer, J. L. E., 473
Duhem, Pierre, 6, 7, 8, 11, 12, 17, 18, 45, 50, 58, 73, 401 f., 485
DURAND, DANA B., 1–20, 21 ff., 50 ff.
Dussaulit, M., 207
Dutens, Leo R., 215

Eddington, Sir Arthur, 484 f.
Edwards, Jonathan, 286, 316, 303, 313
Einstein, Albert, 489
Ellis, H. J., 304
Empedocles, 176
Epictetus, 61
Epicurus, 20, 71, 169, 486
Erasmus, 69, 386 f.
Erler, Georg, 462
Erskine, John, 198
Euclid, 14 ff., 116, 434
Eupolemus, 108
Euripides, 69, 107
Eurytus, 177

Faraday, 485 f.
Farago, Ladislas, 248
Farrell, J., 371
Faulkner, 369, 371
Favaro, Antonio, 473
Fénelon, 327
Ferguson, Wallace, 69
Fibonacci, Leonard, 12
Ficino, Marsilio, 17, 29, 30, 374, 391
Fitzgerald, Scott, 370
Fitch, Robert E., 251
Fontenelle, 439 f.
Foster, William, 113
Fox, George, 274, 310, 314, 304
Frisch, C., 461

Fuller, Rev. Andrew, 194, 212
Furniss, 76, 78, 80, 85
Fynes, 92, 93

Gabirol, Ibn, 14
Galen, 7, 64, 68
Galileo, 1, 6, 7, 10, 14, 17, 18, 31, 37, 39, 40, 41, 44, 47, 50, 51, 52, 53, 58, 400–428, 432, 472, 488
Gartz, J. C., 473
Gassend (i), 225, 471
Gegenheimer, A. F., 491
Gelli, G., 382
G. Gentile, 39
George of Trebizond, 10, 20
Gerard of Cremona, 10
Gesner, Conrad, 469
Gewirth, A., 495
Ghiberti, 17, 43
Gide, Charles, 146
Giese, 464 f.
Gifford, John, 200, 201
Gilbert, 57, 484
Gilman, Margaret, 246
Gladstone, W. E., 131, 327
Glanvill, Joseph, 321
Gordon-Walker, P. C., 360
Gortonists, 307
Gracian, Balthasar, 249
Grandi, 383
Graunt, John, 82, 96, 98
Greenlaw, E., 389, 399
Gregory, 385
GRENE, MARJORIE, 333–348
Grosseteste, 15, 57
Grossman, H., 401
Grubb, Edward, 305
Guicciardi, 26, 37
Guizot, 132

HADAS, MOSES, 105–111
Hailperin, Herman, 257
Haldane, J. B. S., 484
Haldane, J. S., 190
Hale, Matthew, 324
Haller, William, 323, 361–364
Hamond, Walter, 112–118
Hampdens, 348
Hare, Thomas, 139
Harmon, Alice, 250
Harvey, 58
Hazelton, Roger, 250
Heckscher, Eli F., 26, 77–80, 83
Heffner, Ray, 250
Hegel, 133, 451 f., 486 f.
Heisenberg, 488
Helvétius, 128
Heraclitus, 167, 168, 169, 176
Hero, 61
Herodotus, 108, 162, 218
Herrick, Robert, 370
Herschel, 484
Hicks, Granville, 368, 371

Hill, Christopher, 354
Hintzelmann, P., 474
Hipler, Franz, 459
Hippocrates, 64, 68, 107, 108
Hitler, 77
Hitti, Philip K., 490
Hobbes, 320, 321, 322, 326, 327, 347, 430 f.
Hobhouse, L. T., 133
Holmes, Justice Oliver Wendell, 157
Homer, 105, 381 f.
Hood, Thomas, 57
Hooker, Richard, 308, 309, 311, 314, 304
Hooker, Thomas, 258–286, 307
Horace, 69
Hornberger, Theodore, 317
Horsley, Samuel, 210, 211
Houghton, W. E., Jr., 2, 364
Howell, 369, 373
Hughes, E. R., 249
Hughes, Lewis, 193, 194, 210
HUGHES, MERRITT Y., 381–399
HUIZINGA, J., 49, 54, 217–223
Hull, Cordell, 83, 480
Hume, 333–348
Huneker, 369
Hutchinson, Anne, 268, 269, 270, 274, 307, 313
Huxley, 484
Huyghens, 485

Infeld, L., 489

Jackson, Andrew, 220, 222
Jacobus of Cremona, 18, 19
James I, 348, 351, 334
James of Forli, 7
James, Henry, 369, 370, 371, 372
James, Margaret, 354
James, William, 310
Jeans, Sir James, 249, 484 ff.
Jefferson, Thomas, 220, 222, 491, 495
John of Salisbury, 54, 73
Johnson, E. A. J., 83
Johnson, H. E., 492
JOHNSON, FRANCIS, R., 2, 5, 6
Johnson, Henry, 249
Johnson, Edward, 309
Johnson, Dr. Samuel, 77, 85, 95, 100, 112, 310, 311
Jones, Rev. David, 326
Jones, H. S. V., 390
Jones, William, 213
Jowett, 179, 180
Joyce, 66
Junthner, Julius, 105, 107

Kaerst, Julius, 105, 110
Kallen, H. M., 247
Kant, 51, 300, 433 f., 487 f.
Kazin, Alfred, 368–373
Keith, George, 274
Kepler, 14, 30, 41, 52, 53, 461 f.
Kelt, Henry, 198, 210, 211
Kibre, Pearl, 251
Kingsley, Charles, 155
Klibansky, Raymond, 8, 490
Knox, Vicesimus, 195
Köstlin, J., 467
KOYRÉ, ALEXANDRE, 17, 18, 58, 400–28, 471, 495
KRISTELLER, PAUL O., 15, 16, 17, 59–62, 374
Kronenberger, Louis, 370

La Bruyère, 439 f.
Laertius, 61
Laird, John, 251
Lamarck, 477
Landino, C., 388
Lardner, Ring, 372
Larrabee, Stephan, 246
Larkey, S. V., 2, 5, 7
Laski, Harold J., 494
Lasswitz, Kurd, 403
Law, William, 314
Lear, F. S., 495
Leavis, F. R., 98
Lee, Robert E., 221
Lee, Umphrey, 301
Leibniz, 430 ff.
Leland, John, 195, 215
Lenin, 357
Leonardo da Vinci, 1, 12, 19, 40, 44 f., 51, 69 f.
Leroy, Maxime, 477
Lessing, 433
Lewis, C. S., 381
Lewisohn, Ludwig, 370
Lilburne, John, 359, 362
Lincoln, Abraham, 221
Little, Alan M. G., 246
Locke, 337, 342, 343, 436
LOCKWOOD, DEAN P., 63–65
Lovejoy, Arthur O., 12, 33, 38, 181, 308, 384, 392, 495–496
Lovell, H. T., 250
Lucian, 61
Lucretius, 20, 61
Luther, 213 f., 223, 317 f.
Lynskey, Winifred, 250

McColley, Grant, 11, 12
McIlwain, 25, 26
McKay, Herbert, 249

Macaulay, 218
Macaulay, Mrs., 345, 348
MacCurdy, E., 46
Machiavelli, 26, 37, 45, 47, 218, 384
Mach, E., 403, 485
MacKenna, Stephen, 181
Mackenzie, F., 150
MacLaren, M., 492
Macy, John, 370
Mahnke, Dietrich, 8, 14, 53
Malebranche, 430 ff.
Malthus, T. R., 80, 130, 131, 142, 148, 150, 151, 160
Mandeville, Bernard, 78, 79, 81, 320, 322, 327
Maritain, Jacques, 248, 493
Marliani, Giovanni, 7, 16, 17, 18
Marshall, Dorothy, 79, 83 ff.
Marx, Karl, 95, 133, 147, 349, 351 f., 371 f.
Mather, Cotton, 275, 281, 282, 283, 284, 285
Mather, Nathaniel, 283
Mather, Samuel, 282
MATTHIESSEN, F. O., 368–373
Maurus, 73
Maxwell, 486
Mayronis, Franciscus, 12
Mazzoni, Jacopo, 420 f.
Medici, Lorenzo de', 27, 45
Melanchthon, Philip, 467
Menzzer, Rudolf, 472
Merriman, R. B., 354
Mewaldt, Johannes, 105
Meyer, George, 492
Meyerson, E., 402, 411
Michelet, 69, 217, 132
Middeton, N. C., 303
Mill, James, 128, 151, 156
Mill, John Stuart, 127–160
Mill (Mrs.), 128
MILLER, PERRY, 253–286, 304, 361
Milton, John, 76, 362, 386 f.
Minkowski, 487
Mirabeau, 201
Mirandola, Pico della, 16, 29, 30, 32, 56, 388
Mitchell, Wesley C., 82
Mizwa, Stephen P., 460
Molière, 437
Monboddo, Lord, 112
Montaigne, 54, 118, 384 f.
Moody, Ernest A., 11, 14, 15
More, Henry, 225
More, Sir Thomas, 388
Moryson, Sir Richard, 92, 93
Mossner, E. C., 246, 320, 333, 345
MUELLER, GUSTAV, E., 287–300
Muggleton, Lodowick, 307
Muldoon, William, 65
Müller, Adolf, 460
Mun, Thomas, 78, 326, 327
Mussolini, 65, 77
Myers, Gustavus, 493

Nagel, Ernest, 250
Napier, 58

Napoleon, 355
Napoleon III, 152
Necker, J., 197
Needham, Joseph, 366
Nef, J. U., 349, 353
Nelson, Ernest W., 21, 26, 27
Nelson, Norman, 49
Neuman, Carl, 71
Newburger, Otto, 251
Newman, Bertram, 75
Newton, Sir Isaac, 53, 58, 225, 403 f., 436, 472, 485 f.
Nicholas of Cusa, 4, 5, 8 f., 14, 17, 19, 32 f., 41, 46
Nicholls, Sir George, 83, 84
Nicodemus, 65
Nieuwentyt, Bernard, 321, 325
Nisbet, Robert R., 496
Norris, John, 321, 369
North, Sir Dudley, 327
Norton, John, 279, 280, 282
Nourse, Timothy, 321
Novara, Domenico M., 9–11

Ockham, William of, 51, 73, 189, 190
Olmstead, John W., 251
Olschki, Leonardo, 1, 17, 35, 42, 43, 48, 58, 401 f.
Oresme, Nicole, 11, 15, 16, 17, 14, 401 f., 438 f.
Osiander, A., 461 f.
Overton, J. H., 322

Padua, 3 f., 28, 29, 41, 50, 57, 224
Pagel, Walter, 14
Paine, Thomas, 201, 312, 318, 337, 491, 495
Paley, 197
Panaetius, 110
Panofsky, Erwin, 381 f.
Parmenides, 168, 180, 191
Parrington, V. L., 368, 369, 372
Pascal, 75, 423
Patrizi, Francesco, 224–245
Paul of Venice, 16
Pemble, 265, 266, 267
Perkins, William, 257, 259, 260, 262
Perrault, 438 f.
Perry, Charner M., 491
Petegorsky, 357, 359
Petrarch, 29, 35, 71, 72
Petreius, John, 461 f.
Petrus Hispanus, 68
Petty, Sir William, 80, 82, 84, 86, 93, 96, 97
Peurbach, George, 9, 467
Pevsner, N., 251
Philoponos, John, 406 f.
Plato, 33 f., 167–193, 224 f., 291, 301, 400–428, 387 f., 486 f.
Pletho, G. G., 5
Pliny, 73
Plotinus, 61, 181, 187, 191
Plutarch, 61, 193, 383
Poggio, 20
POLINGER, ELLIOT H., 475–483
Polybius, 110, 111
Polycrates of Samos, 162
Pomponazzi, 392, 395
Porter, K. A., 372
Porteus, Bishop, 195, 198, 200, 201
Posidonius, 110, 236
Prentice, Thomas, 196
Preston, John, 257, 259, 260, 262, 261
Priestley, 197
Proclus, 178, 468
Prowe, L., 468, 471 n.
Ptolemy, 4, 5, 9, 10, 18, 20, 36, 66, 67
Pythagoras, 162, 169, 172, 173, 175, 177, 240, 244

Raleigh, Sir Walter, 80
Ramus, Peter, 68
Randall, Jr., John H., 1, 6, 7, 15, 16, 17, 28, 31, 32, 41, 50, 58, 405
Ranke, 23
Ransom, 371
Recorde, Robert, 57
Redern, Count, 476 f.
Reed, John, 369
Regiomontanus, 9, 10, 13, 18, 19, 467
Reid, William, 198
Rennell, Thomas, 199, 213
Rheticus, 459 f.
Richter, J. P., 46, 47, 51
Riemann, 487
Riezler, Kurt, 410
Rist, Charles, 146
Robespierre, 201, 357
Römer, Alfred, 250
Roosevelt, Theodore, 222, 482
Root, H. K., 95, 98
Roscellinus, 188 f.
ROSEN, EDWARD, 457–474
ROSENTHAL, JEROME, 429–456
Ross, W. D., 182 f.
Rousseau, 194–96
Ruggiero, 398
Ruskin, 318
Russell, Bertrand, 127, 484
Russell, Lord John, 135
Ryan, Edward, 194, 215

Sabine, G. H., 38, 39, 357–360
Saint-Simon, 132, 147, 148, 475–83
Salmon, Joseph, 307
Saltus, 369
Salutati, 29
SAMS, HENRY W., 320–332
Sarton, George, 71, 312, 495
Saxl, F., 29
SCHAPIRO, J. SALWYN, 127–160, 251
Schiaparelli, G., 469
SCHILLING, BERNARD, 193–216
Schilpp, Paul A., 247
SCHLATTER, RICHARD B., 349–367
Schneider, Herbert W., 248
Schönberg, Cardinal, 460
Schöner, John, 467
Schreiber, Jerome, 461 f.
Schrödinger, H., 489
Schwartz, Delmore, 370
Scot, Reginald, 395
Scott, Thomas, 196
Scotus, Duns, 190
Seneca, 170, 174
Shaftesbury, 342
Shakespeare, 54, 389
Shephard, Thomas, 276–278
Sherburn, Georg, 95, 98
Sheridan, Thomas, 90, 92
Shoemaker, Francis, 493
Smith, Adam, 76, 77, 82, 130, 142
Smith, Frank, 318
Smith, Norman Kemp, 333
Smith, Preserved, 324, 464, 472
Socrates, 107, 178, 180, 185, 187
Somerville, Thomas, 195, 198
Sosigenes, 468 f.
Spencer, Theodore, 246, 392
Spengler, O., 452
Spenser, Edmund, 381–399
Spinoza, 485
Staël, Mme. de, 477
Stalin, 77
Steinbeck, 87, 371
Steiner, Arpad, 251
Stenzel, Jules, 180
Stephen, Leslie, 75, 91, 128, 131, 150, 320
Stimson, Dorothy, 472
Strong, E. W., 14, 425
Suiseth, Richard, 14, 16
Swift, Jonathan, 75–104

Taine, 75
Tannery, P., 402 f.
Tarn, 109
Tate, 371
Tawney, R. H., 250, 324
Taylor, A. E., 178
Taylor, Edward, 307
Taylor, Harold, 495
Telesio, 224, 225
Terence, 68
Thales, 161–174, 236, 484

Theophrastus, 20, 54, 108, 161
THORNDIKE LYNN, 6–10, 16, 28, 33, 58, 65–74, 406 ff., 495
Tiedeman, 465
Torricelli, 424
Toscanelli, 9, 10, 19, 28, 45
Trinkhaus, C. E. 381 f.
Troeltsch, Ernst, 323, 324
Twain, Mark, 369
Tyler, Coit Moses, 309

Underhill, Evelyn, 302

Valla, George, 12, 385, 468
Valla, Laurentius, 384 f.
Van Doren, Carl, 370
Van Vleck, George W., 492
Vesalius, 57, 64, 67
Vitruvius, 71
Vives, J. L., 385
Voltaire, 81, 193–216, 218, 436 f.

Wasiutyński, Jeremi, 460, 463, 472
Weber, F., 107
Weber, Max, 55, 323
Webster, Daniel, 220
Weddell, Captain John, 113 f.
Wellek, René, 251
Wells, H. G., 155
Wells, Henry W., 492
Wesley, John, 314, 307, 317
Wharton, Edith, 369, 370
Wheelwright, John, 270, 271
White, Lynn T., Jr., 58
White, Morton G., 247
Wieleitner, 16
WIENER, PHILIP P., 50, 484–489
Willard, Samuel, 258, 281–85
Willey, Basil, 320
William of Moerbeke, 18, 19
Williams, Roger, 271, 312
Wilson, Edmund, 94, 98
Wilson, Woodrow, 479
Winstanley, G., 357, 358, 359, 360
Winthrop, John, 254, 266, 269, 271
WITTKOWSKY, GEORGE, 75–104
Wohlwill, E., 403
Wolf, A., 473
Wolf, Rudolf, 472 f.
Wolfe, Thomas, 369, 370, 371
Wolff, Leonard, 462 f.
Wollstonecraft, Mary, 136
Woodhouse, A. S. P., 360–362
Wordsworth, 129, 490
WRIGHT, LOUIS B., 112–118, 323, 490
Wright, Thomas, 321
Wylie, Elinor, 371

Xenocrates, 185
Xenophanes, 161–176

Zabarella, 8, 405
Zanchius, Jerome, 385, 396
Zeno, 109, 168
Zilsel, Edgar, 2, 42, 43, 364, 401
Zinner, Ernst, 8–13, 467

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